

REVISIONS OF NATURE: SPECTACLE, GENDER, AND PUBLIC SCIENCE RHETORIC  
IN EIGHTEENTH-CENTURY GREAT BRITAIN

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## **ABSTRACT**

Chelsea Redeker Milbourne: Revisions of Nature: Spectacle, Gender, and Public Science  
Rhetoric in Eighteenth-Century Great Britain  
(Under the direction of Jordynn Jack and Jane Danielewicz)

In eighteenth-century Great Britain, public audiences witnessed an astounding array of new scientific spectacles, such as hot air balloons, static electricity generators, microscopic creatures, and natural exotica brought back from foreign travels. My dissertation investigates how these spectacular science displays, as well as audiences' varied responses, helped constitute public interest and understanding about science. My research argues that science spectacles offered opportunities for public audiences to negotiate the place of emerging scientific theories and technologies within eighteenth-century cultural spheres. By engaging with the marvelous, the monstrous, and the possibly fraudulent, public audiences debated what natural objects and perceptions counted as "real," which should be valued, which should be censured, and which should transition from novelty to familiarity as they became more fully integrated within eighteenth-century life. In particular, I examine women's enthusiastic, and often overlooked, participation in public science spectacles, including the ways that their interest and embodied participation augmented the spectacle of science displays as well as the ways that women negotiated the potential for their displays of scientific knowledge to become spectacles in a pejorative sense. In this manner, my dissertation demonstrates how public science spectacles generated uncertainties not only about changing scientific theories and technologies but also about notions of gender, decorum, social class, and educational access. Ultimately, this project

contends that science spectacles engendered widespread public interest in science during the eighteenth century yet also, conversely, fueled anxieties that public interest could become too popular, fashionable, and thus unintellectual.



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gardens and therefore should not be referred to as emerging technology in eighteenth century Great Britain.

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## TABLE OF CONTENTS

LIST OF FIGURES .....	ix
CHAPTER 1: INTRODUCTION: SPECTACLE, GENDER, PUBLIC SCIENCE .....	1
Watching and Gawking: Public Science in the Eighteenth Century.....	8
Theorizing Public Science .....	17
The Activity of Public Engagement.....	20
Reflexive Circulation .....	22
Identity Formation .....	24
Significance.....	26
Chapter Outlines .....	27
CHAPTER 2: WOMEN AND THE EMERGENCE OF SPECTACULAR PUBLIC SCIENCE.....	30
Defining Spectacle .....	37
Excess, Contradiction, and Amplification: Spectacular Means of Disruption .....	40
Anticipating Women’s Responses .....	54
CHAPTER 3: POLITE SCIENCE AND THE SPECTACLE OF WOMEN’S LEARNING .....	58
Women and Polite Spaces.....	63
“Air Balloons [and] ye Marriages Talk’d of Particularly”: How Women Used Scientific Spectacles to Facilitate Politeness and Mediate Polite Social Spaces.....	71
Directing Presence .....	72
Displaying Absence .....	83

Conclusion .....	94
CHAPTER 4: FASHIONABLE SCIENCE AND WOMEN SPECTATORS AT THE ROYAL INSTITUTION.....	96
Creating a Public Institution: The Leadership of the Royal Institution .....	103
Cultivating an Expansive Scientific Public: Humphry Davy's Lectures.....	110
Contested Public Science: Audience Responses and Representations .....	121
Conclusion .....	127
CHAPTER 5: CONCLUSION: SPECTULATIONS ABOUT SPECTACLES.....	129
The Use of Disruption in Public Science.....	133
The Range of Public Science Spectacles .....	135
The Impact of Audience and Extended Context on the Experience of Public Science Spectacles .....	137
The Circulation of Public Science Spectacles .....	140
The Value of Having Diverse, Networked Uses for Public Science .....	142
REFERENCES .....	148

## LIST OF FIGURES

Figure 1: Illustration from <i>The Young Gentleman and Lady's Philosophy</i> (1755-1765) .....	1
Figure 2: Illustration of an Air-Pump from <i>New Experiments Physico-Mechanical, Touching the Spring of the Air and Its Effects</i> (1660) .....	10
Figure 3: <i>An Experiment on a Bird in the Air Pump</i> (1768) by Joseph Wright of Derby .....	14
Figure 4: Illustration from <i>Entretiens sur la Pluralité des Mondes</i> (1686) .....	30
Figure 5: <i>Beauty in Search of Knowledge</i> (1782) .....	58
Figure 6: Rotunda at Ranelagh Gardens by Thomas Bowles (1754) .....	79
Figure 7: The Royal Institution of Great Britain painted by Thomas Hosmer Shepard (circa 1838) .....	96
Figure 8: Illustration of Humphry Davy from <i>Famous Men of Science</i> (1889) .....	111
Figure 9: View of the Royal Institution of Great Britain (2011) .....	128

## INTRODUCTION: SPECTACLE, GENDER, PUBLIC SCIENCE



Figure 1: Illustration from *The Young Gentleman and Lady's Philosophy* (1755-1765), a popular science dialogue in which fictional characters learn about natural philosophy

Eighteenth-century Great Britain was acknowledged as a wonder-working age.<sup>1</sup> Although the Enlightenment was a time recognized for its devotion to rationality, new methods of scientific inquiry, and a rise in public debate, it was also an era dedicated to fashion,

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<sup>1</sup>In *London Unmask'd: or The New Town Spy*, the narrator refers to the eighteenth century as a “wonder-working age, in which invention seems to be on the rack to produce such curiosities as surpass whatever have gone before” (135).

consumption, and the increasing importance of leisure. During this period, the growing middle and upper classes had access to a new range of luxury goods and recreational novelties. As Art Historian Barbara Maria Stafford notes, “more and more people had the means to travel at home and abroad, go to the theater, browse fairs, attend lectures, build laboratories, gape at cabinets of curiosities, buy fashionable gadgets for themselves and the latest toys for their children” (*Artful Science* xxi). In addition to these entertainments, male and female audiences alike indulged their taste in spectacular science demonstrations such as those including mechanical automata, microscopes, hot air balloons, static electricity generators, and air-pumps—displays that science popularizers and demonstrators argued were important precisely because they were both educational *and* entertaining.

Accounts from this era suggest that audiences were enthralled by and deeply suspicious of the profusion of novelty, which included a dazzling array of scientific marvels as well as new technological innovations. As seen in the pages of the *Morning Post*, an eighteenth-century periodical, writers proudly announced, “This is the age of inventions!” (November 7, 1786) even as others voiced concerns that the “rage for novelty is now constituted to be the prevailing one, and every man who gives public exhibitions must consult it” (October 6, 1785). Such comments exemplify the strong reactions that displays of novelty provoked, attracting audience attention and admiration as well as sparking audience anxieties about the proliferation of unfamiliar sights and experiences.

Recent scholars have argued that the rage for spectacles—or displays of novel objects and practices—in the eighteenth century can be understood as an attempt to make sense of the expanding market for goods and information. Eighteenth-century scholar Paul Keen maintains that print debates about spectacles were more than passive accounts of Britain’s changing

commercial landscape. Instead, reflections about spectacles, including judgments ranging from delight to dismay, served as active attempts to intervene within British culture. Historians John Brewer and Roy Porter have even gone so far as to claim that “one of the historical tasks of what we may loosely call the Enlightenment was to forge new sets of moral values, new models of man, to match and make sense of the opportunities and obligations, the delights and the dangers, created by the brave new world of goods” (5). As spectacles were involved in the display and circulation of novelty goods in this period, they became instrumental to public negotiations about the meaning and value of unfamiliar objects and practices.

My research investigates a specific kind of eighteenth-century spectacle—the public science spectacle. In this study, I explore how public experiences with spectacular science demonstrations mediated the ways that British audiences made sense of developing scientific theories and technological objects. I examine how public science spectacles engaged diverse audiences in the task of determining whether and to what extent strange new scientific theories and objects should be incorporated into familiar experiences. By partaking in the marvelous, the monstrous, and the possibly fraudulent, public audiences debated what natural objects and perceptions counted as “real,” which should be valued, which should be censured, and which should transition from novelty to familiarity as they became more fully integrated within eighteenth-century life.

Specifically, I investigate eighteenth-century public science spectacles as instances of *public science*. Although spectacular demonstrations of natural and mechanical wonders undoubtedly challenged audiences’ perceptions of their natural environments,<sup>2</sup> public science

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<sup>2</sup>Scholars including historians Jonathan Crary and Iwan Rhys Morus as well as rhetorician Jordynn Jack have argued that historical figures were taught to see their material surroundings in particular ways. An example of the historical contingency of sight can be found in Jack’s research on seventeenth-century science advocate Robert Hooke. She argues that Robert Hooke developed a “pedagogy of sight” in his work *Micrographia*, which taught audiences to



spectacles also raised troubling questions about how revolutionary scientific theories and objects might impact public culture. Audiences wondered, and often worried, if learning about science might influence their conceptions of religion, morality, education, personal identity, or public engagement. Notably, public science was not intended to “produce or reproduce factual truths, but to come to shared determinations” about how individuals should live together (Condit 12). My research thus examines how science spectacles helped mediate public debates about the role of science in British public culture.

Like recent scholars who have investigated historical science popularization and public responses to science, I view eighteenth-century public science as more than a one-way distribution of scientific information from elite scientific practitioners to lay audiences.<sup>3</sup> Further, public science was not simply the domain of lay audiences, as is sometimes implied by the term “popular science.” Instead, I argue that public science in the eighteenth-century functioned as an activity system<sup>4</sup> distinct from legitimate scientific experimentation that nevertheless worked to determine how scientific matters might inform and impact public culture. In other words, public science brought together myriad individuals, including those within burgeoning scientific communities as well as those with limited access to scientific education, to negotiate how science might be utilized outside of scientific communities for activities such as manufacture,

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view microscopic insects in ways that complemented the mechanistic view of nature espoused by the Royal Society of London.

<sup>3</sup>Historians such as Roger Cooter and Stephen Pumfrey, Larry Stewart, Jan Golinski, and Iwan Rhys Morus have argued for the importance and complexity of science popularization in the seventeenth through nineteenth centuries. Collectively, they dismantle assumptions that science popularization was the straightforward distribution of scientific knowledge from elite practitioners to passive, lay audiences. In contrast, they argue that popularization efforts were critical in gaining widespread public support for the new epistemology, that popularizers tailored scientific lessons for particular audiences, and that popular audiences contributed to the scientific enterprise through their financial and cultural patronage.

<sup>4</sup>In using the term “activity system,” I am drawing upon Yrjö Engeström’s work, which analyzes how human activities are deeply interconnected with their contexts, both social and material, are systematically constituted through myriad individual actions, and are continually transformed across time (65-73).

religion, and courtship. My research investigates how public science spectacles functioned rhetorically as discursive and performative sites that enabled science popularizers *and* their audiences to imagine how science might re-envision cultural as well as natural perceptions.

In particular, my project examines women's engagement with public science and the gendering of public science spectacles. Gender was an unmistakable aspect of public science during this period, both in women's considerable support for public science activities and in the tendency for eighteenth-century audiences to conceive of spectacles, scientific or otherwise, as distinctly feminine. I contend that paying attention to women's participation and the gendering of public science spectacles helps to better theorize the production and reception of science displays as spectacular. For example, examining women's involvement in public science spectacles highlights how the interpretation of science spectacles was frequently dependent upon the audiences' perceptions of each other. During the eighteenth century in Great Britain, women's visible presence in the audience of public science displays often became spectacles in their own right by disrupting common expectations for gendered behavior. Women's remarkable behavior not only intensified the spectacle of scientific demonstrations but also prompted questions about the appropriate boundaries of women's science education and public behavior. Ultimately, I argue that investigating public science spectacles through the lens of gender is vital to understanding the ways that science spectacles cultivated widespread and enthusiastic interest in science yet also, conversely, served to devalue public science through associations with women, entertainment, and fashion.

The eighteenth-century in Great Britain represents a particularly clarifying moment to examine public engagement with science. Of course, public interest in science did not begin in the eighteenth century. Gentleman virtuosi had collected natural curiosities and debated

revolutionary theories within select circles since the early modern period (Findlen; Daston and Park). Likewise, emerging scientific societies and academies across Britain and the European continent sponsored public demonstrations of scientific experiments during the seventeenth century (Stewart). Despite this early interest, the eighteenth century stands out as a period of enormous expansion in the public's interest in science. Over the course of the century, the burgeoning fields of natural philosophy and natural history sparked collective imaginations and became as intriguing for audiences in "fairs, shops, and boulevards" as they were for audiences in "academies and learned societies" (Bensaude-Vincent and Blondel 1). Amateur enthusiasts like Alexander Pope collected natural exotica and referred to themselves as members of the "Virtuoso-class," while authors like Eliza Haywood encouraged young women to explore the flora and fauna of their gardens with portable magnifying lenses, and middle class audiences flocked to public science shows to see the latest displays of chemical combustion and nitrous oxide inhalation.<sup>5</sup> Science thus became a popular subject for those within—or aspiring to join—polite society, and "not to endorse natural philosophy in some shape or form...was to be a misfit out of tune with the whole spirit of the age" (Rousseau 267).

As members of the fashionable world, women from the middle and upper classes were critical in making science a popular endeavor. Although a limited number of eighteenth-century women acted as scientists, such as Caroline Herschel who worked alongside her famous brother and was credited with discovering a comet, much larger populations of women participated in public science activities. During the eighteenth-century, women educated themselves through popular science literature and textbooks, attended public science lectures and shows, performed experiments within their homes and gardens, conversed about the latest scientific topics, and

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<sup>5</sup>Examples of eighteenth-century public interest in science can be found in the publications of G. S. Rousseau (267), Eliza Haywood (134), and Jan Golinski ("Humphry Davy" 21).

taught the next generation about novel scientific perspectives. Leading scientific figures such as Benjamin Franklin also encouraged women to pursue their popular science interests, suggesting that knowledge of scientific topics would increase a woman's religious devotion as well as her ability to converse with men of sense and learning.<sup>6</sup> Science popularizers further recognized women as influential in circulating and shaping public opinions about science. In their efforts to make science public, appealing and accessible to diverse audiences, popularizers sought out female audiences to act as patrons, promoters, and paying customers for popular science works. For this reason, as science historian Alice Walters has argued, popular science texts, especially those seeking to connect science with polite endeavors, were "distinguished by their conspicuous emphasis on developing and sustaining a female audience" (130). Women were thus welcomed as audiences for spectacular demonstrations of science, and, as I will argue throughout this dissertation, their participation often intensified public perceptions of scientific displays as spectacular.

In this study, I research the rhetorical practices surrounding public science spectacles and the role of this rhetoric in the constitution of public science in the eighteenth century. To this end, I trace the rhetorical practices that produced public science spectacles, the means by which such spectacles were interpreted and circulated by their heterogeneous audiences, and the effects of these spectacles on public perceptions and uses of science. Within this project, I ask: How did the framing of science as spectacular persuade audiences to explore radically new visions of both nature and culture? How did science advocates attempt to mediate science spectacles, intensifying and diminishing novelty to produce a range of spectacular effects? How did audiences circulate and transform public science spectacles, making some public science perspectives more durable while letting others fall out of favor? How did the gendered behavior

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<sup>6</sup>Benjamin Franklin's comments about women's science education can be found in chapter two.

of women watching public science spectacles influence public interpretations of science and impact public uses of science outside of specialist communities? Finally, how did public science spectacles mediate how audiences interacted with each other through public science?

In pursuing these questions, I argue that public science spectacles helped to facilitate a scientific public, a diverse and networked association of people who witnessed and performed their interest in science for each other and, through these rhetorical practices, collectively negotiated how public audiences would understand, engage with, and value science. My research also suggests potential contemporary applications for this historical research. I suggest that, like the eighteenth century in Great Britain, the present moment contends with the quick pace of scientific and technological change and often struggles with integrating science into public culture. I argue that the rhetorical practices that enabled robust public science participation in the eighteenth century might also benefit contemporary attempts to promote public interest in science, advance public science literacy, and cultivate responsive public debates about the role of science in public life.

### **Watching and Gawking: Public Science in the Eighteenth Century**

My investigation of public science in the eighteenth century begins by analyzing the dichotomy between witnessing and watching science, as theorized by science and feminist studies scholar Donna Haraway. In her work on the history of science in seventeenth-century Great Britain, Haraway maintains that a problematic division emerged between legitimate scientific experimentation—*witnessing* science—and popular science consumption—*watching* or *gawking* at science. She claims that since the time of Robert Boyle and the Royal Society of London, “only those who could disappear ‘modestly’ could really witness with authority rather than gawk curiously. The laboratory was to be open, to be a theater of persuasion, and at the

same time it was constructed to be one of the [scientific community's] ...most highly regulated spaces” (Haraway 25). Under this taxonomy, eighteenth-century activities such as viewing a hot air balloon ascension, displaying natural curios in a decorative cabinet, or teaching children about astronomy with celestial globes would not be considered part of the legitimate work of scientific experimentation. There is a sense that such activities enabled audiences to watch or learn about science but were not part of the active endeavor to discover new scientific facts. They were instances of *watching* rather than *witnessing* science. The division between witnessing and watching, Haraway argues, inevitably created power inequities, privileging original, and serious, experimentation over seemingly passive, and recreational, gawking. This divide further constructed arbitrary boundaries between the affairs of scientists and those of popular culture. Though Haraway attends to the division between witnessing and watching to critique and reappraise what counts as legitimate scientific experimentation, my research focuses critical attention on the public work performed by watching, and even gawking, at public science spectacles. In this section, I investigate the rhetorical work accomplished by witnessing and then watching science spectacles by analyzing two accounts of the same demonstration—first witnessing and then watching a bird in the glass receiver of an air-pump. With this comparison, I argue that audiences watching and gawking at public science spectacles participated in public science, a distinct means of engaging with scientific matters. Through public science, eighteenth-century public audiences advanced the scientific program not by collecting new scientific facts but by cultivating diverse audience interest in science and channeling that interest into debates about how science should converge with matters of public concern.

A famous instance of scientific witnessing can be found in Robert Boyle’s experiments with the air-pump, documented in *New Experiments Physico-Mechanical, Touching the Spring*

of the Air and Its Effects (1660). In his text, Boyle recounts his multiple trials with the air-pump, a recently designed device that evacuated air from a large glass receiver. By removing the air from the receiver, the air-pump could create a partial vacuum and thus offer a means to test theories about air and fluid pressure (figure 2).

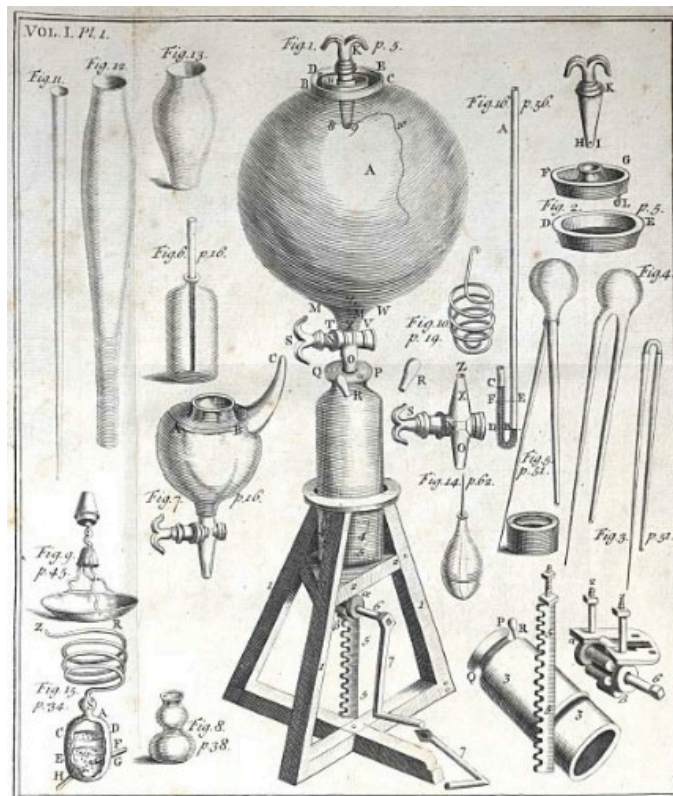


Figure 2: Illustration of an Air-Pump from *New Experiments Physico-Mechanical, Touching the Spring of the Air and Its Effects* (1660)

In one set of experiments, Boyle documented the extent to which the removal of air would impact a living creature—in this case a bird—placed inside the glass receiver. Initially, Boyle considered the experiments to be “so strange” and “scarce probable” that the removal of air for so short a period of time could kill a “perfectly sound and living Animal” (360). Because of the strangeness of the initial phenomena, Boyle felt obliged to make the experiment several times and even saw the benefit of having multiple audiences observe it: “Which sort of Experiments seem so strange, that we were oblig’d to make it several times, which gain’d it the Advantage of

having Persons of differing Qualities, Professions and Sexes, (as not only Ladies and Lords, but Doctors and Mathematicians) to witness it” (360).<sup>7</sup> However, as Boyle’s report demonstrates, he would later consider some members of the audience to be better suited to the task of experimental witnessing than others.

Over the course of multiple experiments, Boyle decided on the benefit of having fewer audience members witness the strange phenomena of the bird in the air-pump. Though Boyle initially allowed diverse audiences to observe the air-pump experiments, his accounts show that their presence tended to disrupt the scientific trials, so much so that he eventually decided to perform the experiment without extraneous spectators. For example, in one experiment, in which Boyle was testing whether the narrowness of the receiver contributed the bird’s distress, a bird was placed in an unevacuated air-pump receiver. Boyle reported that the bird was cheerfully eating seeds and “liv’d ten minutes, but had probably liv’d much longer, had not a great Person, that was a Spectator of some of these Experiments, rescu’d him from the prosecution of the Tryal’ (360-361). In another instance of interruption, Boyle was observing a bird struggling after the removal of air when ‘by the pittty of some Fair Lady’s...who made me hastily let in some Air at Stop-Cock, the gasping Animal was presently recover’d, and in a condition to enjoy the benefit of the Lady’s Compassion” (361). In order to prevent spectators from interfering in the experiments before they were concluded, Boyle and his unnamed companions, “being resolv’d not to be interrupted in our Experiment” chose to perform the experiment again “at night” (361) without additional spectators. In these scenes, we begin to see a division between the *witnessing* performed by experimental philosophers and the *watching* enacted by those whose presence and bodies were apt to disrupt the experiment.

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<sup>7</sup>Historical quotations often include numerous capitalizations and italicizations; unless otherwise stated all stylistic emphases in quotations are in the original.



Scientific witnessing would become a critical feature in the emerging discipline of experimental philosophy that was engendered through the work of Robert Boyle and the Royal Society of London. Seeking to establish matters of fact—knowledge that was less certain than mathematical theorems yet more robust than personal opinion (Shapiro)—the Royal Society instituted a program of empirical observation and experimentation that would establish and attest to matters of fact through witnessing.<sup>8</sup> Yet as seen in Boyle’s report on the bird in the air-pump experiments, not everyone could adequately function as a witness, either because they disrupted the experimental performance or because their testimony was not deemed credible. Thus, while publicity was critical to the experimental project—gaining collective assent for an empirical experience through witnessing—experiments were often conducted away from the sight of those who could not witness appropriately, as seen with the air-pump experiment held at night.

The restrictions about who could and could not legitimately witness scientific experiments, and thus participate in the “public” space of the laboratory, were not limited to individuals’ technical know-how or philosophical knowledge. Instead, experimental philosophers also needed to possess a certain orientation towards experimentation: a gentlemanly modesty that ensured the trustworthiness of the man as an experimenter and as a witness (Shapin and Schaffer 65). The performance of gentlemanly modesty—seen as self-effacing and civil behavior—acted as a testament to an experimental philosopher’s ability to bracket personal opinions and serve as the “transparent spokesmen” for natural objects and experimental technologies (Haraway 25). Unlike the “great Person” or the “Fair Lady’s” who kept interrupting Boyle’s air-pump trials,

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<sup>8</sup>According to sociologists Shapin and Schaffer, “[m]atters of fact were the outcome of the process of having an empirical experience, warranting it to oneself, and assuring others that the grounds for their belief were adequate. In that process a multiplication of the witnessing experience was fundamental. An experience, even of a rigidly controlled experimental performance, that one man alone witnessed was not adequate to make a matter of fact. If that experience could be extended to many, and in principle to all men, then the result could be constituted as a matter of fact” (25).

modest experimenters and witnesses should be able to report on experimental outcomes without interference from their bodies or personal opinions.

The emphasis on modesty and self-effacing behavior bolstered the credibility of experimental claims, but it also initiated problematic boundaries between those who witnessed scientific experiments and those who watched. Highlighting the way that the scientific community sought to efface their bodies and personal perspectives, science critic Sharon Traweek has characterized the scientific community as “the culture of no culture” (162). Although the scientific community certainly went to great lengths to establish a culture, one that privileged gentlemanly modesty, Traweek’s comment highlights the importance that members of the scientific community placed on ignoring their personal biases and the cultural conditions of their bodies during scientific experimentation. Men of science were thus marked by their persistent attempts to bracket culture from the sites of experimentation. Through this separation, the early experimental community encouraged a “boundary between watching and witnessing, between who is a scientist and who is not, and between popular culture and scientific fact” (Haraway 33). Though the gentlemanly modesty required for legitimate witnessing has been critiqued as a gendered and classed concept that made it difficult for women and men from the laboring classes to participate in legitimate witnessing (Potter)<sup>9</sup>, this perspective has also been problematic for delegitimizing the important work of watching science. For, if witnessing science required a sharp division between science and culture, then watching science became an important site for diverse classed and gendered audiences to debate how science should intersect with public affairs.

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<sup>9</sup>Even if women or men from the laboring classes possessed philosophical knowledge or technical know-how, they were often considered too emotional or unruly, their bodies too visibly connected with politics and culture for their accounts to be unbiased or rigorous. Restricted from witnessing, those without the requisite gentlemanly modesty were thus relegated to another sphere of participation—watching and gawking at scientific demonstrations.

A second representation of the air-pump demonstration, one that depicts audiences *watching* the spectacular display, offers an example of the distinct rhetorical work performed through scientific consumption. The second air-pump representation comes from the iconic Joseph Wright of Derby painting *An Experiment on a Bird in the Air Pump* (1768) (figure 3). Like the air-pump experiment described in Boyle's *New Experiments Physico-Mechanical, Touching the Spring of the Air and Its Effects*, this painting depicts a live animal placed within the glass receiver of an air-pump. Unlike Boyle's representation, however, this scene should not be considered an experiment, or a moment of scientific witnessing, despite the title of the painting. The audience shown in the painting is not attempting to collect empirical data, and, ostensibly, they have some idea of what will happen to the bird when the air is evacuated from the air-pump. Instead, they are watching and reacting to the spectacle of the scientific display.



Figure 3: *An Experiment on a Bird in the Air Pump* (1768) by Joseph Wright of Derby,  
© National Gallery, London

Importantly, this painting shows that watching scientific demonstrations offered an opportunity for larger proportions of the eighteenth-century population to observe and engage with new technologies like the air-pump and scientific concepts like the “spring in the air.” The distinct behaviors of the audience members encircling the air-pump further demonstrate the variable ways that non-specialists chose to engage with scientific demonstrations. Close to the center of the work, for instance, we see a father figure with two little girls, who seem to be experiencing the same distress as the ladies in Boyle’s company over the fate of the bird in the air-pump. Despite the girls’ obvious discomfort, the father figure continues to point at the display, suggesting that the air-pump was considered an important educational, perhaps even cultural, lesson for young middle-class girls. In the lower right, we can see an older gentlemanly figure seemingly contemplating the life and death implications of the air-pump display. Throughout the eighteenth century, natural philosophy was considered to be a religious aid, enabling audiences to reflect on the majesty of God’s creation (Stewart), and the older gentlemen seems to be engaging with the demonstration in that manner. On the left we see a young boy gawking at the show, oblivious to the moral overtones and seemingly interested only in his own entertainment. At the far left, we see a young man and woman who are more interested in watching each other than the events on display. Not to be written off merely as inattention, the young couple’s behavior demonstrates that the air-pump display was deemed an appropriate moment for courtship and interaction between young men and women. *An Experiment on a Bird in the Air Pump* thus offers a visual argument for the interest of diverse audiences and the openness for what public audiences thought they could do with natural philosophy outside of the spaces of legitimate experimentation.

Critically, this painting suggests the visible impact that audience members of scientific demonstrations had on each other: how they could become part of the public science display and how their awareness of each other could color their interpretations of the scientific principle on display and the place of science within eighteenth-century culture. The emphasis on the audience hints that watching and gawking is not simply about watching the display but about watching each other.<sup>10</sup>

My research thus seeks to analyze the rhetorical work performed by watching and gawking at spectacular science demonstrations, such as the one depicted in the Wright of Derby painting. Although it is vital to continue work on who can legitimately participate in scientific *witnessing*, perhaps refashioning not only the who but the how of scientific experimentation, I argue that it is also necessary to reexamine representations of scientific *watching*, which have often been overlooked as passive, unthinking, classed, or gendered gawking. I contend that watching science—understood broadly as engaging with science outside of legitimate scientific experimentation—presented an opportunity for non-modest audiences to debate how the new experimental philosophy would impact their lives and identities as well as popular culture. As watchers, whose embodied performances and discursive responses were visible to other audience members, eighteenth-century audiences shaped arguments about how emerging technologies should be used within public spaces, evaluated the ethics of certain scientific practices, and negotiated how the new experimental way of life might be extended to those outside of specialist communities like the Royal Society. Critically, moments of watching offered eighteenth-century

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<sup>10</sup>Historian Iwan Rhys Morus similarly argues that the audiences for Victorian scientific performances were attentive to each other: “To be successful, Victorian scientific spectacles and performances had to engage with and recruit their spectators. To understand scientific performances, we need to understand the very local specificity of audiences rather than reducing them all to a common type. If they were really all the same, then they are neither interesting nor particularly helpful as explanatory tools. Audiences constituted themselves as the public through their active participation in performances. They went there avidly to see and be seen as part of the same publicly declarative act of belonging. In a matter of speaking, the audience at scientific performances were on stage too” (“Worlds of Wonder” 816).

audiences a means of engaging with science that did not efface bodies, biases, or emotions but blatantly took such factors into consideration. For if public rhetoric consists of the “communicative interactions through which members of a community share with each other their good reasons for choosing courses of action together,” then these reasons will necessarily include “evidence and logic” as well as “social values and affective relationships and identities” (Condit 12-13). In this study, I argue that watching scientific spectacles functioned as a form of public science rhetoric, which enabled diverse coalitions of specialist and non-specialist audiences to negotiate public understandings and collective courses of action with regard to changing scientific and technological developments. This view of responsive, heterogeneous public science participation should not be mistaken for a specialist community (or in their image) but a public open to those with interest, which managed to blend instruction with entertainment, prompted continued education and debate, and seriously attempted to blend matters of science with those of political and cultural concern.

### **Theorizing Public Science Rhetoric**

In analyzing the watching of scientific spectacles as a form of public science rhetoric, I am building upon a body of scholarship that questions the passivity of seemingly non-productive, consumptive, and everyday practices like watching. As media scholar and legal theorist Lawrence Lessig acknowledges, it is “easy for us to miss the active in the mere watching” (7).<sup>11</sup> Yet scholars who analyze the practices of users, consumers, and watchers such as Michel de Certeau contend that these activities hold the potential for creative production and

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<sup>11</sup>I acknowledge that this sense of watching (e.g. watching a television program) is more specific than the non-modest watching discussed in the previous section (scientific interest that is not part of legitimate scientific experimentation). However, both uses of watching refer to activities that are primarily characterized by reception or consumption rather than active production.

interpretation.<sup>12</sup> de Certeau uses the act of reading as an example of how consumption, in this instance of written media, is not a simple and unambiguous transfer of content. Arguing for the reader's capacity to forge his or her own pathway through a text, de Certeau claims "the activity of reading has on the contrary all the characteristics of a silent production: the drift across the page, the metamorphosis of the text effected by the wandering eyes of the reader, the improvisation and expectation of meanings inferred from a few words, leaps over written spaces in an ephemeral dance" (xxi). Functioning within the confines of the written media, the reader nevertheless possesses the ability to skip between passages, bring previous experiences to bear, make unintended connections, and allow "a different world (the reader's)" to slip into "the author's place" (xxi). The production in a practice like reading is not in the creation of a product but in the "art of using" (de Certeau 31). de Certeau claims that the art of using, also characterized as "styles" or "ways of operating," can be used to reimagine everyday practices like walking, cooking, or watching as active endeavors that can creatively reinterpret given products (30). If we apply this perspective to Wright of Derby's painting *An Experiment on a Bird in the Air Pump*, we can see how the pictured audience engages in different "styles" of watching the scientific display, ranging from the gawking child to the contemplative gentleman to the flirtatious couple. The air-pump demonstration presents a particular view of a scientific scenario—the evacuation of air from the air-pump receiver—but the audiences' styles of watching offer creative interpretations of how one might use the display—for instruction, for

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<sup>12</sup>de Certeau explains: "As unrecognized producers, poets of their own acts, silent discoverers of their own paths in the jungle of functionalist rationality, consumers produce through their signifying practices something that might be considered similar to the 'wandering lines' ('*lignes d'erre*')... 'indirect' or 'errant' trajectories obeying their own logic. In the technocratically constructed, written, and functionalized space in which the consumers move about, their trajectories for unforeseeable sentences, partly unreadable paths across space. Although they are composed with the vocabularies of established languages (those of television, newspapers, supermarkets, or museum sequences) and although they remain subordinated to the prescribed syntactical forms (temporal modes of schedules, paradigmatic orders of space, etc.), the trajectories trace out the ruses of other interests and desires that are neither determined nor captured by the systems in which they develop" (de Certeau xviii).

entertainment, for moral reflection, or for courtship. In this manner, the audience's arts of using contribute to the meanings associated with the science display. The popularizer or operator of the air-pump is not the only person offering a display or being watched.

When viewed as an active performance or use, rather than simply consumption, watching science spectacles can be theorized as a form of public science rhetoric. In addition to close readings of particular instances of public science rhetoric, my study examines how multiple instances of public science rhetoric, or scientific watching, functioned collectively to constitute public opinions and applications for science. In other words, I explore how individual instances of public science rhetoric coalesced and fragmented into commonplaces that authorized audiences to speak and act with regards to science in particular ways. In order to investigate both the development and transformation of public science engagement over the course of the eighteenth century, I rely on recent public theory scholarship, which accounts for the ways that publics and avenues for public participation are variously created, maintained, and allowed to fade.

In using public theory scholarship to analyze public science activity in the eighteenth century, I am reminded that the immense appetite and enthusiasm for public science displays during this era emerged alongside the formation of the bourgeois public sphere, often through similar places and publishing networks. Famously theorized by Jürgen Habermas, the rise of the bourgeois public sphere in the eighteenth century displayed new forms of public rational-critical debate amongst diffuse and often unknown participants, which presented a previously unseen counterbalance to state and monarchical power. Although Habermas's initial analysis of the bourgeois public sphere as an ideal public has been frequently contested and retheorized, his scholarship has produced a robust conversation about the rhetoric of public engagement both in



the eighteenth century and afterwards. I argue that this body of public theory scholarship provides a productive framework to examine science popularization in the eighteenth century as an ongoing rhetorical negotiation about the meaning and utility of new scientific theories and objects as matters of public interest. I am particularly interested in public theory scholarship that emphasizes the active nature of public engagement, focuses on the reflexive circulation of communication within publics, and attends to the links between public participation and identity formation. Utilizing such scholarship helps to account for public science rhetoric that has been previously overlooked, such as the public science activities that were performed by women, which often occurred in domestic spaces and were circulated through embodied performances and polite conversation.

### *The Activity of Public Engagement*

To start, my project draws upon public theory scholarship that foregrounds the “action or activity” (Brouwer and Asen 8) of public formation. Instead of focusing on the locations of public participation or the gathering of certain participants, which can often lead to problematic boundaries between public and private participation, recent public theory scholarship has begun tracing the activity of public participation. This perspective enables scholars to attend to the public activities that occur in seemingly private spaces or through informal conversations.

One such theorist examining the activity of public engagement is rhetorician Gerald Hauser, who argues that communication is constitutive of public formation. Hauser contends that publics emerge through discursive exchanges, which he terms “vernacular rhetoric.” As implied by the term “vernacular,” Hauser pays attention to the ways that multiple, heterogeneous exchanges contribute to a “network of associations from which and in which a communally sustained consciousness of common meanings are developed and enriched” (34). Drawing from

Hauser, rhetorician Jenny Rice similarly argues that “talk is the very substance through which publics come to be formed” (Rice 19): “Rather than thinking of publics (or counterpublics) as bodies that join together in deliberation in a discursive arena, I prefer to think about publics as active manifestations of talk” (19). Importantly, for Hauser and Rice, the communication that constitutes publics is not necessarily political, institutional, critical, or rational.<sup>13</sup> Instead, Hauser argues that “[t]he means by which active citizens address one another are often less formal than institutional discourse, and their sites are not limited to institutional forums. More typically, in fact, a public’s members converse through the everyday dialogue of symbolic interactions by which they share and contest attitudes, beliefs, values, and opinions” (36). These “vernacular exchanges” include “our daily conversations with coworkers, neighbors, superiors, subordinates, community and church contacts, group members, friends, and family” and open a “discursive space that exceeds the boundaries of entirely personal and private matters” (64-65). It is through such vernacular exchanges, multiplied over time, that we are included “in the social conversation by which we learn and also contribute to themes that inculcate shared motives” (Hauser 64-65). This emphasis on conversation as constitutive of publics is useful because it helps to theorize the activities of public formation beyond institutional spaces and with individuals other than citizens or voters—perspectives that can often overlook the public activity that occurs in ostensibly private spaces or with individuals who cannot cast a ballot.

Drawing from Hauser and Rice’s theories in my own work on eighteenth-century public science rhetoric, I particularly focus on the vernacular exchanges that emerged around scientific topics and which, I argue, informed public opinions about science. Public perceptions of science

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<sup>13</sup>The emphasis on rational-critical debate is a particular point where Hauser revises Habermas’s initial theorization of the public sphere. Hauser argues that Habermas’s insistence that public discourse must be rational-critical is too restrictive and does not account for the many vernacular exchanges that do not always meet this criterion (Hauser 61).

did not arise solely from the lectures of science popularizers but were also influenced by audience responses and by the daily conversations that were not always associated with moments of explicit science instruction.<sup>14</sup> I thus concentrate not only on the public science demonstrations but on the audience conversations that developed around public science spectacles and which served to extend, revise, and contest the messages advanced by science popularizers and leading scientific figures.

### *Reflexive Circulation*

My theorization of public science rhetoric further builds upon public theory scholarship that foregrounds the continued reflexive circulation of texts in the constitution and maintenance of publics. Public theory scholar Michael Warner, for example, has argued for the necessity of multiple circulating and reflexive texts in constituting public activity. He insists that

[n]o single text can create a public. Nor can a single voice, a single genre, even a single medium. All are insufficient to create the kind of reflexivity that we call a public, since a public is understood to be an ongoing space of encounter for discourse. No texts themselves create publics, but the concatenation of texts through time. Only when a previously existing discourse can be supposed, and when a responding discourse can be postulated, can a text address a public. (90)

Warner maintains that it is “the way texts circulate, and become the basis for further representations, that convinces us that publics have activity and duration” (97). This perspective benefits my research by arguing for the importance of continued and circulating discourse about science spectacles. In addition to examining audiences’ immediate reactions to public science

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<sup>14</sup>Scholarship on the public sphere has reevaluated its spatial component, arguing that scholarly analysis of public activity should not exclude events in domestic spaces. Specifically speaking about the eighteenth century, historian Lawrence Klein contends that “[w]hat people in the eighteenth century most often meant by public was sociable as opposed to solitary (which was ‘private’). ‘Sociability’ here meant involving the company of others in a range of different settings and combinations” (104). This understanding of public as sociable is important because it suggests that the “distinction between the private and the public did not correspond to the distinction between home and not-home” (104-105). Thus, “people at home, both men and women,” were capable of participating in public activities, including public science.

spectacles, I also examine the circulation of audiences' responses and how these serve as the basis for further representations.

Complementing Warner's view of publics as engendered through "the concatenation of texts through time" (90), rhetoric theorists have advocated that a broad range of compositional practices be included in an analysis of public participation. Rhetoric and composition theorists David M. Sheridan, Jim Ridolfo, and Anthony J. Michel, for example, have emphasized the importance of analyzing multimodal texts—compositions that contain multiple modes such as images, sounds, textures, etc.—as well as alphabetic texts in the formation of publics. Similarly rhetoricians Daniel C. Brouwer and Robert Asen have pointed to the possibility of multiple "manners" of public address: "[p]ublic engagement may utilize verbal and visual symbols, statistical evidence, narrative testimony, formal argumentation, tactical consumerism, humor, sentimentality, corporeality, and more" (16). This perspective allows for a study of public science rhetoric that can attend to multiple forms of communication such as embodied performance or affective appeals, which can often be overlooked in a public analysis focused solely on rational-critical debate.

An example of the extended circulation of science spectacles, which includes multimodal forms of communication, can be seen in the eighteenth-century account of a static electricity generator demonstration. In a letter to a friend on March 20, 1747, Elizabeth Carter asks,

Was you ever electrified? We have an itinerant philosopher here, who knocks people down for the moderate consideration of sixpence, and men, women, and children are electrified out of their senses. The fine ladies forget their cards and scandal to talk of the effects of electricity. The squires flock out of the villages to bring themselves and their dogs to be electrified; and the very boys and girls in the streets break their teeth with long hard words in describing the wonders of *tricity*. (*A Series of Letters* 129)

This passage provides an example of the continued circulation of talk about scientific displays as well as the audiences' attention to each other, including their embodied performances of scientific interest, even after the display has concluded.

### *Identity Formation*

Finally, my theorization of public science rhetoric is informed by the link between public participation and identity formation. Public sphere theorist Nancy Fraser has argued that publics are “not only arenas for the formation of discursive opinion; in addition, they are arenas for the formation of and enactment of social identities” (125). Rice extends this by suggesting that public discourse “helps to create particular kinds of *public subjectivities*,” in which people “imagine themselves in relation to...publics” (13-14). The connection between public participation and identity formation becomes important for eighteenth-century public science because audiences frequently questioned how popular engagements with science, such as conversing about scientific topics, might impact existing identities and social relationships. Much of the discourse, displays, and embodied performances that constituted public science engaged the topic of whether studying science would alter individuals and how this could transform their relationships with each other. For example, eighteenth-century mothers were concerned about what too much scientific education might do to their daughters. It was argued that scientific education would make young women less frivolous—more devoted to religion and common sense than gossip or cards. Such education might even improve a young women’s conversation and help her catch a scientifically minded husband. However, mothers also worried that too much education would spoil their daughters, making other women jealous and earning the contempt of men for overstepping acceptable bounds of propriety. At the crux, such public science debates were not about scientific theories or technologies but the ways that these might

mediate social interactions. How, for instance, might social relationships change when diverse and unfamiliar audiences began speaking to and observing each other participating in public science?

My analysis thus investigates how public science spectacles contributed to widespread public science participation in the eighteenth century. In this work, I analyze individual instances of public science rhetoric, particularly performing and watching public science spectacles. I additionally account for the ways that public science spectacles were circulated, repeated, modified, and contested by female audiences. This approach, which attends to the ongoing production, circulation, and transformation of science spectacles, helps to view science popularization as part of a “cultural circuit” (Scott 5) rather than the terminus of a simple unidirectional transfer of knowledge from elite scientific practitioners to lay audiences. Moreover, my attention to women’s participation and the gendering of public science spectacles foregrounds the ways that public science spectacles informed contemporaneous debates about changing public culture. As will be discussed in the remainder of this dissertation, eighteenth-century science spectacles not only challenged notions of physical reality (e.g. Earth’s position at the center of the solar system) but also challenged notions of social reality (e.g. women’s right to education and the appropriateness of women speaking knowledgeably in front of mixed audiences). I argue that the popularity and efficacy of public science spectacles helped to constitute a responsive scientific public in the eighteenth century—one that encouraged widespread and diverse public science participation while also grappling with concerns about what the rapidly changing technological landscape might do to existing cultural beliefs.

## *Significance*

Public science participation in the eighteenth century presents a wide area for study. There has already been important scholarship on the rhetoricity of science popularization in the eighteenth-century. Science historian Larry Stewart has examined how successful science popularizers persuaded English audiences to accept highly complex Newtonian theories by linking such theories with national pride, religious devotion, and manufacturing advancement. Jan Golinski has similarly analyzed the popularization of chemistry within English and Scottish gentlemanly circles, arguing that science was an essential component of eighteenth-century audiences' perceptions of Enlightenment culture (*Science as Public Culture*). Barbara Gates and Ann Shteir have further investigated women's role in popularizing science through teaching, writing, and public speaking starting in eighteenth-century England. My research complements such scholarship by focusing on the rhetorical impact of watching science spectacles in the eighteenth century, which was often labeled as consumption or entertainment. I argue that watching science spectacles played a valuable role in constituting and contributing to public science. I further explore how audience responses to spectacular displays of science, analyzed as public science rhetoric, prompted the continued circulation and mediation of public perceptions about science and provided opportunities for on-going negotiations about how science should intersect with matters of public concern.

My research also contributes to current rhetorical scholarship. First, my analysis of watching science as a form of public science rhetoric links scholarly conversations in the rhetoric of science with those in public rhetorics. Exploring public science rhetoric allows for greater attention to the important middle ground between professional and technical scientific communication and popular science entertainment. This work contributes to the research of

rhetoric of science scholars who are also interested in science popularization such as Charles Bazerman, Susan Wells, Jeanne Fahnestock, J. Blake Scott, and Celeste Condit. I argue that critical attention to science spectacles, as well as audience uptake and redeployment of science spectacles, enriches scholarship on how public audiences learn about science as well as how audiences become invested in public debates about science.

My project further contributes to feminist rhetorical scholarship by exploring the rhetorical agency of women in the audience of public demonstrations. Women need not occupy the podium or pulpit to have significant rhetorical impact; their embodied and discursive actions as audience members, and their subsequent circulation and adaptation of meanings, can also impact public debates. My research thus takes up recent calls in feminist rhetorical scholarship by Jacqueline Jones Royster and Gesa Kirsch to attend to the circulation of feminist rhetorical action. I argue that women's watching, participation in, and reiteration of science spectacles served to augment the wonder of science displays and prompt additional circulation.

## **Chapter Outlines**

This dissertation includes three chapters, each analyzing a different application of public science spectacle.

The first chapter, "Women and the Emergence of Spectacular Public Science," examines how popular science textbooks used spectacles to solicit public audiences for science. Works such as Benjamin Martin's *The Young Gentleman and Lady's Philosophy, By Way of Dialogue* (published serially 1755-1765) included textual representations of science spectacles that introduced new scientific theories and disrupted previous expectations about the physical world. In this chapter, I analyze the rhetorical strategies that science popularizers used to present scientific lessons as spectacular. I further show how popular science textbooks used depictions of



women to augment the wonder of science displays—such as showing a young woman’s beautiful skin to be scaly and rough when viewed under a microscope. This chapter thus demonstrates how disruptions to gender expectations and decorum were used to heighten public awareness and fascination with science in the early-to-mid eighteenth century.

Chapter two, “Polite Science and the Spectacle of Women’s Learning,” examines how women negotiated the spectacle of their public interest in science. Scientific figures like Benjamin Franklin claimed that studying science would improve a woman’s conversation and make her more appealing to the opposite sex. However, letters, essays, and poetry show that eighteenth-century women were both intrigued by and skeptical of such claims. They recognized that women’s displays of scientific knowledge could become unflattering spectacles. Focusing mainly on the *Bluestockings*, a conversational circle of men and women who discussed intellectual topics, I examine how women negotiated the spectacle of their scientific knowledge displays and how they used such displays to advocate for their preferred forms of polite social behavior.

Chapter three, “Fashionable Science and Women Spectators at the Royal Institution,” examines the spectacle that women caused as audiences for public science lectures and shows. Although women were seemingly silent as audience members in public lectures, their presence was, at times, deemed more spectacular than the events on stage. A series of incidents at the Royal Institution, when women taking notes during public chemistry lectures agitated male audience members, suggests both the rhetorical impact that audiences can have on each other and the difficulties in maintaining an expansive scientific public.

My dissertation concludes with a brief account of how research on eighteenth-century public science spectacles can speak to contemporary concerns about a lack of public science

literacy or public involvement in science policy. My research ultimately points to the importance of having extended contexts of embodied scientific encounter, in which diverse publics can visibly engage in scientific activities for multiple ends. In the eighteenth century, watching scientific spectacles served to integrate science within multiple forms of life, from politics to religion, conversation to courtship, thereby producing a robust scientific public.

## WOMEN AND THE EMERGENCE OF SPECTACULAR PUBLIC SCIENCE

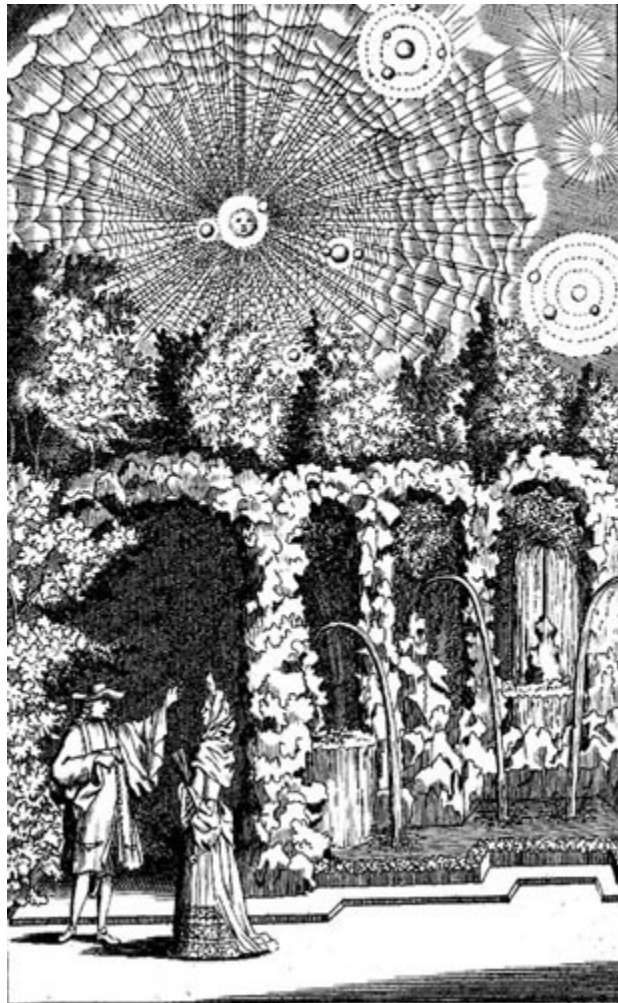


Figure 4: Illustration from *Entretiens sur la Pluralité des Mondes* (1686)

In 1686 Bernard Fontenelle published *Entretiens sur la Pluralité des Mondes*—translated as *Conversations on the Plurality of Worlds*. Written as a dialogue, *Entretiens* presents a series of fictional conversations between a male narrator and a Marquise, an intelligent and aristocratic lady, who discuss natural philosophy as they walk around a cultivated estate garden. Before the

dialogue begins, Fontenelle addresses the audience in a preface and announces his desire to showcase the latest theories of astronomy and physics in a manner that is “neither too dry for men and women of the world nor too playful for scholars” (3). In fact, he suggests that his subject matter is ideal for such an attempt because it appeals to both the mind and the imagination: “the ideas of physics are pleasing in themselves and, at the same time that they’re satisfying the mind, they provide a *spectacle* for the imagination which pleases it as much as if they had been made expressly for that purpose” (5, emphasis mine). Throughout the remainder of the dialogue, Fontenelle seeks to satisfy both the intellect and the imagination of his readers, arguing that both strategies are needed to excite broad public interest in natural philosophy.

Particularly appealing to the audiences’ imagination, Fontenelle consistently, and with great skill, presents astronomical phenomena and new philosophical theories as spectacles. Using the dialogue structure, Fontenelle shows his characters captivated by new theories about the Copernican model of the solar system and the possibility of life on other planets. Setting the stage for these intriguing conversations, Fontenelle’s narrator begins his account by describing his wonder at the night sky:

One evening after supper we went to walk in the garden. There was a delicious breeze, which made up for the extremely hot day we had had to bear. The Moon had risen about an hour before, and shining through the trees it made a pleasant mixture of bright white against the dark greenery that appeared black. There was no cloud to hide even the smallest star; they were all pure and shining gold and stood out clearly against their blue background. *The spectacle set me to musing*, and I might have gone on like that for some time if it had not been for the Marquise. (9, emphasis mine)

Throughout the text, Fontenelle’s narrator characterizes the heavens as spectacular, even comparable to elaborate theatrical productions found in French operas. He contends that “nature is very much like an opera house” in that both natural and theatrical spectacles are “arranged to give the most pleasing effect” (11). The pleasing effect, however, is not simply the result of

abundant sensory detail. Fontenelle maintains that natural spectacles, like theatrical productions, are also appealing because they have hidden mechanisms, like the “wheels and counter-weights that make everything move” behind the opera stage (11). Fontenelle contends that “[w]hoever sees nature as it truly is simply sees the backstage area of the theater” (12). This description of nature, presuming that parts of it are hidden from sight, suggests that spectacle, for Fontenelle, is not just about excessive sensory experience but also about curiosity. Part of the pleasure comes from not knowing how aspects of natural phenomena work and letting the imagination grapple with these unknowns.

Augmenting the natural spectacle of the night sky is the spectacle of the Marquise’s contributions to the philosophical conversation. The male narrator expresses his awe and admiration for the Marquise’s comments, her conversation showing that she is as adept at understanding astronomy as she is engaging in the witty and flirtatious repartee that was common in polite seventeenth-century social encounters. The Marquise’s presence suggests that Fontenelle sought to heighten the perception of astronomical spectacle by causing additional sensations in the surrounding social and physical setting of the dialogue.

Fontenelle’s dual appeal to the intellect and the imagination was hugely popular in both France and later in Great Britain. By 1803, over a century after the first publication of *Entretiens*, there were seven different English translations, including Aphra Behn’s *Discovery of New Worlds* (1688). In addition to translations, English authors produced numerous imitations such as John Harris’s *Astronomical Dialogues between a Gentleman and a Lady* (1719), Benjamin Martin’s *The Young Gentleman and Lady’s Philosophy* (1755-1765), and James Ferguson’s *The Young Gentleman and Lady’s Astronomy, familiarly explained in ten dialogues between Neander and Eudisia* (1768). These public science texts adopted Fontenelle’s stylistic choices, including

the characterization of philosophical topics as spectacular *and* the use fictional dialogues between male and female characters.

This chapter investigates the presentation of science as spectacular in eighteenth-century public science texts. Early modern and eighteenth century public science texts presented audiences with radical new theories of the natural world, which often contradicted individual sense perceptions as well as religious and cultural traditions. Within *Entretiens*, for example, Fontenelle sought to convince audiences to entertain new theories about the Earth's place in the heavens, to discount their senses which perceived the sun tracking across the day-time sky, and instead to see the apparent motion of the sun as evidence for the Earth's movement. Revolutionary ideas, like the sun replacing the Earth at the center of the solar system, were complicated, abstract, and often frightening, especially for audiences with limited education. While gentleman virtuosi had been dabbling with unorthodox theories and collecting natural curiosities since the early modern period (Findlen), these novelties were less familiar outside of aristocratic circles in the eighteenth century. In this chapter, I examine how science popularizers, such as Fontenelle and authors who adopted his style, sought to introduce philosophy as an appealing and appropriate subject available to wide audiences, including the emerging middle class and female audiences. I argue that spectacles in eighteenth-century public science texts functioned as critical components of instructional lessons, offering amusing opportunities for audiences to reflect upon and entertain radical new visions of nature. My investigation further suggests that appeals to women—as fictional characters and real audiences—augmented the spectacle of public science texts and served as additional rhetorical resources to challenge existing perceptions of the natural world.

In using the term spectacle, I recognize that this concept has been understood in myriad ways. Historians Lorraine Daston and Katherine Park have demonstrated that the meaning of concepts like wonder and curiosity oscillated from the middle ages through the mid-eighteenth century, taking on nuanced definitions and valuations based on the communities who used such terms and the wider material and social contexts in which they were embedded. As a corollary term to wonder and curiosity, spectacle has been similarly viewed in various lights. At times, spectacle has been understood as a pleasurable, if somewhat superficial, pastime of the upper classes and in other moments it has been conceived as a vulgar, and even soporific, display for those who work for a living. The eighteenth century in Great Britain presents a transitional moment for spectacle, particularly science spectacles, which were emerging beyond the province of the gentleman virtuosi but were still not considered the domain of the untutored.<sup>15</sup> For the purposes of this dissertation, I recognize the diversity of meaning surrounding spectacle, both in what counted as a spectacle and in valuations of spectacle based on the typical audience. However, my analysis of eighteenth-century science spectacles utilizes a particular understanding of spectacle, one that is influenced by Fontenelle's characterization. I see eighteenth-century science spectacles as sensational demonstrations of scientific content that also possessed an element of uncertainty. By foregrounding the uncertain, the unfamiliar, and the novel—often in dramatic or eye-catching ways—science spectacles called upon audiences to experiment with new scientific content. In this chapter, I first account for the rhetorical strategies that science popularizers used to position new scientific theories and technologies as spectacular—including excess, contradiction, and amplification. Not all eighteenth-century scientific content was inherently striking; scientific concepts like the spring in the air were not

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<sup>15</sup>As will be seen throughout this chapter, eighteenth-century science popularizers presumed that spectacular science displays would appeal to diverse audiences, including those across the class spectrum.

readily visible and popularizers sought to enhance the novelty of their displays. I further argue that by positioning scientific content as spectacular—sensational as well as unfamiliar—science popularizers increased the presence of new scientific theories, disrupted previously held perceptions of the natural world, and maintained audience interest after the first wave of curiosity was over.

Critically, my examination of spectacle in eighteenth-century public science texts demonstrates that the perception of novelty or uncertainty was frequently dependent upon the extended material and social context of science spectacles. In addition to disrupting expectations for physical reality, authors of public science texts disturbed familiar expectations for place, audience, and cultural norms like gender in order to amplify the novelty of the scientific display. An example of how the unfamiliar behavior of those in the audience, learning about science, could be an additional source of novelty occurs in a 1713 article from the *Guardian* magazine. In this article, the author expresses his surprise at a group of women who read a translation of *Entretiens* aloud to each other while making fruit preserves:

It is always the Custom for one of the young Ladies to read, while the others are at work, so that the Learning of the Family is not at all prejudicial to its Manufactures. I was mightily pleased, the other Day, to find them all busie in *preserving* several Fruits of the Season, with the *Sparkler* in the midst of them, reading over *the Plurality of Worlds*.<sup>16</sup> It was very entertaining to me to see them dividing their Speculations between Jellies and Stars, and making a sudden Transition from the Sun to an apricot, or from the Copernican System to the figure of a Cheese-cake. (Steele *Guardian* 2: 332)<sup>17</sup>

In addition to reading about spectacles described in the Fontenelle translation, the women in this passage generate a scene of spectacle for the observing reporter, who comments on the “entertaining” connections between “Jellies and Stars” that are constituted in this situation. The

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<sup>16</sup>During the eighteenth century, “sparkler” referred to “one who sparkles or shines in respect of beauty or accomplishments; *esp.* a vivacious, witty, or pretty young woman” (OED). Here, the term seems to be referring to the young woman reading *Entretiens* to her female relatives.

<sup>17</sup>This article appears in the No. 155, Tuesday, September 8, 1713 edition of *The Guardian*.



reporter's observations highlight how women's participation in scientific learning often brought together unfamiliar components that contributed to the over-arching sense of spectacle.

Fontenelle and other public science authors who followed his style often depicted the extended scenes of scientific instruction—providing details about the space, the participants, their social practices, etc. in addition to vivid descriptions of natural philosophy. In this manner, the new objects and theories of natural philosophy were connected to the scene of philosophical learning, creating a tangled web of unfamiliar associations. Indeed, part of the amusement provided by science spectacles was in perceiving scientific novelties within familiar spaces and letting these new and strange additions unsettle previously established practices, associations, and even identities. I argue that part of the novelty and enjoyment came from the new connections, such as those between “the Copernican System” and “the figure of a Cheese-cake,” and from newly-combined activities, such as reading astronomy while making preserves, that public science spectacles offered eighteenth-century audiences.

Ultimately, I maintain that science spectacles, such as those depicted in public science texts, invited public response. Certainly, novel and sensational displays of science attracted diverse audience attention and offered amusement in addition to instruction. However, spectacular demonstrations also prompted audiences to collectively question their previous perceptions and explore new ways of seeing and thinking about the natural world. Such questioning could have far-reaching consequences, particularly when science popularizers relied on disruptions to social and material contexts in order to augment the spectacle of a scientific display. By foregrounding sensational and unfamiliar uses of science, popularizers offered playful, ambiguous, and exploratory models for how non-specialist, public audiences might engage with scientific matters. These models prompted public audiences to not only to learn

about science but also to imagine how their scientific lessons might impact their existing perceptions, practices, identities, and relationships.

### **Defining Spectacle**

Spectacles, as suggested by historical science displays, and as defined in this dissertation, are textual, visual, embodied, and/or material displays that exceed ordinary experience. Rather than blending in with familiar experiences, spectacles make audiences pause. They disrupt common associations, perceptions, and beliefs by introducing notable new actors—both human and non-human—or by rearranging relationships between existing actors.<sup>18</sup> I argue that through the incorporation of notable new actors or relationships, spectacles have the ability to interfere with previous associations and create new and, for some audiences, surprising connections. In this fashion, spectacles have the potential to constitute and mediate networks of association.

This understanding of spectacle represents a divergence from previous accounts of spectacle in both common usage and scholarship. Common usage of the term spectacle covers a broad range of phenomena. At times, the term refers abstractly to any object of observation, as in the thing viewed by a spectator. More frequently, spectacle refers to a sensational display—such as a museum exhibition or a circus performance. This use of spectacle is also often tinged with a negative connotation, perceiving spectacle as something excessively ornate or superficial.

Rhetorical scholarship on spectacle, like common usage, contains multiple definitions that are often tailored to a specific historical time or case study. Examples of historically or contextually specific definitions of spectacle include Kristie Fleckenstein's concept of the medieval European "decorous spectacle" or Wendy Hesford's account of contemporary "human rights spectacles." And much scholarship, particularly that which follows Guy Debord's

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<sup>18</sup>This interpretation of eighteenth-century public science spectacles is influenced by sociologist Bruno Latour's actor-network theory, which contends that actors, both human and non-human, can "transform, translate, distort, or modify" existing associations" (39).

understanding from *The Society of the Spectacle* emphasizes the negative effects of spectacle. Specifically referencing the spectacles produced by late-twentieth century media, Debord sees spectacles as mechanisms for distracting modern audiences from political engagement—a “permanent opium war” (44) that reifies dominant power structures and encourages audiences to unthinkingly adopt the status quo. Recent scholarship on spectacle that follows Debord has moderated aspects of Debord’s argument while still accepting some of his premises. In particular, I am persuaded by Wendy Hesford’s recent discussion of Debord in *Spectacular Rhetorics*. Hesford accepts some of Debord’s points, such as the possibility for spectacles to reinforce dominant ideologies, while eschewing others, such as his contention that spectacles mask a reality existent beyond the discourse of spectacle, in her contention that human rights spectacles which replay scenes of violence and suffering can extend the ideological and material conditions that they seek to ameliorate (15-17). Rhetorical scholars David Procter, Michael Halloran, and Kristie Fleckenstein have similarly shown how spectacles such as patriotic celebrations, pageants, and courtly proceedings can generate and reinforce dominant community values and beliefs. These accounts, however, suggest that this process does not occur unproblematically and that there is always the potential for interruption, competing voices, and the lessening of a spectacle’s influence over time.

Examining in more detail how spectacles can disrupt common perceptions, recent scholarship from rhetoric and communication studies has suggested that spectacles can also act as potent forms of social and political critique. Communication studies scholars Kevin DeLuca and Jennifer Peebles have argued that contemporary activists have used spectacular protests, or image events, to gain media attention for their causes: “activists participate through the performance of image events, employing the consequent publicity as a social medium for

forming public opinion” (134). In this manner, image events perform “critique through spectacle” (134). Similarly, rhetoricians Jerry Blitefield, Mari Boor Tonn, and Jennifer Borda have shown how historical civil and labor rights activists have employed spectacles to garner attention for rights abuses and advocate for changes in existing political relations. This research shows that spectacles can be powerful rhetorical tools for disruption, particularly in achieving presence—the “extent to which an object or concept is foremost in the consciousness of the audience members” (Hill 28)—for the objects or people on display.

While acknowledging that spectacles can reinforce dominant ideologies as well as present opportunities for critique, the definition of science spectacle used in this dissertation focuses on how spectacles can interrupt familiar associations and constitute alternative associations. This understanding of spectacle is based on the science spectacles found in eighteenth-century public science texts that sought to interfere with familiar beliefs about the natural world and suggest new ways of seeing and engaging with nature. As will be discussed in more depth in the next section, science popularizers used a variety of strategies to disturb accepted premises about nature, including the use of excessive and evocative sensory details, the juxtaposition of contradictory ideas, as well as the introduction of novel objects and associations. Using this perspective, I demonstrate how the juxtaposition and inclusion of novel actors, both human and non-human, within science demonstrations complicated eighteenth-century networks of association. I argue that eighteenth-century science spectacles, particularly those found in public science texts, disrupted stable meanings and perceptions by (repeatedly) drawing presence to unfamiliar or mismatched combinations of objects, sense perceptions, theories, and practices.

## **Excess, Contradiction, and Amplification: Spectacular Means of Disruption**

This section examines how eighteenth-century science popularizers framed scientific content as spectacular. While members of elite scientific communities like the Royal Society relied on scientific demonstrations to produce repeatable experiences and perform precise measurements (Shapin and Schaffer 25), science popularizers often used the same instruments and demonstrations to foreground uncertainty and contingency. More disruptive and eye-catching than experimental, public science demonstrations prompted audiences to rethink old givens and entertain new possibilities. In this section, I demonstrate how science popularizers used the rhetorical strategies of excess, contradiction, and amplification to cultivate audience uncertainty. I further show how such strategies invited audiences to dwell upon new theories, to question past beliefs, and to continue their interest and engagement with science.

Beginning with the first of these characteristics, excess is a familiar feature of historical spectacles such as parades, pageants, and theatrical performances. Representations of spectacles in popular media often note the ornamentation, decoration, and repetition found in spectacular displays, yet these are commonly described as superficial or insubstantial embellishments. Eighteenth-century science spectacles, however, show that excess—through the proliferation of details, repeated actions, or exaggerated behaviors—can mediate existing associations by adding new connections or disrupting familiar relationships between human and non-human actors.<sup>19</sup>

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<sup>19</sup>A somewhat recent example of how excess could disrupt existing relationships occurs in Jerry Blitefield's account of twentieth-century labor and civil rights protests. Blitefield analyzes a particular spectacle organized by Baltimore activist group BUILD to rally against discriminatory banking practices. During the event, members of BUILD convened at a local bank and overwhelmed the tellers and bank managers with their tedious and unending tasks. As documented in *IAF 50 Years: Organizing for Change* (1990) and quoted by Blitefield: "some brought in five-hundred pennies that they needed converted into dollars. Some wanted balances checked. Some wanted to talk about new or old accounts. Some were clumsy and dropped their change; others were forgetful and forgot their account numbers. All, however, after conducting their one transaction returned to the back of the line to wait their turn to conduct more business" (IAF 19). Although police officers responded to the scene, the protesters were able to continue as they all had bank accounts and were there to "conduct business." The excess of bank transactions, exaggerated to the point where they stymied other bank business, eventually convinced the bank president to meet with BUILD leaders and negotiate more favorable lending practices. Blitefield suggests that the strategy of the

An example of how eighteenth-century science popularizers relied upon excess to cultivate a sense of wonder and disrupt the audience's familiar routines and perceptions occurs in Benjamin Martin's *The Young Gentleman and Lady's Philosophy* (1755-1765). This text, inspired by Fontenelle's *Entretiens*, was written as a fictional dialogue between a brother and a sister. In one scene, the characters experiment with a solar microscope—a new microscope design that projected a hugely magnified image onto a screen or interior wall within a darkened room. Using the solar microscope, the characters examine a variety of natural objects such as fish scales, insect wings, newt tails, and microscopic eels. Fascinated by the sight of a gigantic fish scale, projected onto a drawing-room wall, one of the characters, Euphrosyne, exclaims: “you amaze me, when you say it is only the Scale of a Sole:----It appears at least 12 or 15 Feet long and 6 or 8 Feet wide;----it fills almost the Side of the Room” (2: 185). As can be seen by Euphrosyne's reaction, part of the appeal of the solar microscope was its ability to produce an exaggerated image. Audiences could examine tiny, and perhaps even mundane, objects like fish scales in startling new ways by observing them magnified, expanded, and splashed across a drawing-room wall.

The disruption, however, was not limited to the images' exaggerated size or unusual placement within a domestic space. As seen in another demonstration of the solar microscope, excessive magnification could also disrupt previous judgments about natural objects and encourage new perspectives. Describing the surprising sight of a magnified scarab beetle's wing, Euphrosyne begins to question her past perceptions:

Is this... the Wing of a small, contemptible Scarab? *I think this is the richest, and most glorious Spectacle I ever saw*, and can scarce help looking upon it as the Height of

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BUILD leaders succeeded by “violating tacit rules of appropriate behavior” (264). The repetition and proliferation of familiar actors—such as bank customers, transactions, lines, account numbers, loose change, etc.—distorted familiar associations until they transformed the situation, disrupting the usual order of the bank.

Nature's Fancy, in Point of Grandeur;----it seems all an embroidered Ground of Gold, embossed and studded with Diamonds, in such beautiful and regular Squares of Cheques and Compartments, as nothing but an actual View of such a high finished Piece could ever raise an Idea of. (2: 187, emphasis mine)

The increased detail, made visible through the solar microscope, presents a markedly different image of the scarab beetle's wing that, according to Euphrosyne, must be seen to be believed. Hinting at the intersections between excess and contradiction found in eighteenth-century science spectacles, this scene uses excess in order to foreground a shift in Euphrosyne's perspective. The magnification and subsequent projection of the scarab beetle's wing provides an initial visual contradiction to the experience of looking at a "small, contemptible" beetle without magnification. However, the use of excessive verbal detail in the dialogue ensures that the audience dwells upon the disruption. Euphrosyne repeatedly associates the beetle's wing with gold, diamonds, and grandeur. The number and repetition of these details serves to strengthen the new associations between the scarab beetle and costly materials, which can be fleeting if they are not maintained. This example demonstrates how excess could be used to draw audience attention to particular features—at times reinforcing familiar associations and at times, such as this instance, overwhelming previous associations with copious detail.

In addition to excess, eighteenth-century science spectacles also utilized contradiction to position their scientific lessons as spectacular. Contradiction, as a form of disruption, has a long tradition within the field of rhetoric as a means of cultivating presence, increasing interest through uncertainty, and creating interpretive spaces for new meanings. Contradiction as a rhetorical strategy can be traced back to the Sophists in ancient Greece, as Susan Jarratt contends in her rereading of the historically maligned group. She maintains that the sophists relied on *antithesis*, a playful pairing of opposites, in their style and arguments to disrupt "complacent givens" (23). She maintains that the sophistic use of *antithesis* was not about "exposing or

discovering the unknown, but rearranging the known. Invention is collapsed with arrangement as a single rhetorical canon” (28). A more contemporary account of contradiction and rearrangement can be found in Kenneth Burke’s theory of “perspective by incongruity” or “planned incongruity,” which uses mismatched or antithetical combinations to gain insight.<sup>20</sup> Briefly, Burke contends that “perspective by incongruity” is a method for “verbal ‘atom cracking,’” in which a “word belongs by custom to a certain category—and by rational planning you wrench it loose and metaphorically apply it to a different category” (*Attitudes Toward History* 201-202).<sup>21</sup> Disruption through the juxtaposition of incongruous items, which usually belong to different categories or pieties, creates ambiguity within accepted linkages and presents opportunities for new perspectives.<sup>22</sup>

Similarly, eighteenth-century science popularizer John Harris relied on contradictory juxtaposition to galvanize his reading public into a greater understanding of natural philosophy. Writing in the style of a dialogue, Harris published *Astronomical Dialogues Between a*

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<sup>20</sup>Burke elaborates his definition of this theory while still acknowledging that this is a frequent strategy used by groups such as satirists as well as the Dadaists. Similar to the notion of contradiction discussed in this paragraph, one of Guy Debord’s recommendations for addressing the problem of spectacle was the practice of “*détournement*,” or the “turning aside” or ironic “rearrangement of pre-existing elements” (Knabb 45).

<sup>21</sup>Burke gives as examples the metaphors of “decadent athleticism” and “that big dog, the lion,” which “violat[e] the ‘properties’ of the word in its previous linkages” and reveal “hitherto unsuspected connectives” (*Permanence and Change* 90). These two examples pertain to violations of verbal associations, but Burke also suggests a material application of perspective by incongruity in his discussion of gargoyles—material statues which have conjoined human and bird features (*Permanence and Change* 112).

<sup>22</sup>A more contemporary example of disruption through contradiction can be seen in Mari Boor Tonn’s analysis of the spectacular labor protests organized by Mary Harris “Mother” Jones in the early twentieth century. Tonn describes how “Mother” Jones used embodied performances such as the “Children’s March,” in which young textile workers appealed to colonial imagery by dressing in costumes and holding placards with Revolutionary War slogans, to advocate for new federal child labor regulations. Tonn claims that this appeal to Revolutionary War themes, along with appeals to the sanctity of childhood, produced notable incongruities for the audience: “For onlookers subject to escalating cultural rhetoric romanticizing childhood...or with relatively cosseted offspring of their own, frail youngsters bearing placards identifying them as textile workers set against pleadings for common childhood ‘pursuit[s] of happiness’ created incongruities capable of forging new perspectives on standard factory practices” (244). Although Jones’s staged spectacles concerned some of her contemporaries—they worried that she was diverting attention from the “specifics of contract disputes” (243)—Tonn suggested that Jones understood that “theatrical events helped to focus rather than divert the public eye, to galvanize public sentiments, not to deflect them” (243).



*Gentleman and a Lady: Wherein the Doctrine of the Sphere, Uses of the Globes, And the Elements of Astronomy and Geography are Explain'd* (1719) as a “diverting” (iii) account that could prompt “useful and real Learning” (iv). In his text, Harris seems especially concerned about correcting false conceptions of natural philosophy, and he assures his readers, including an imaginary “Fair Astronomer,” that he will “shew her at first the Cælestial World just as it is; and teach her no Hypotheses which, like some other things taught at Places of great Name, must be unlearned again, before we can gain True Science” (v-vi). His efforts to divert audiences as well as correct past misconceptions include the use of contradiction. For example, when describing the components and use of a pair of terrestrial and celestial globes, Harris’s male narrator explains that there is, in fact, no such thing as an “Upper Hemisphere” when referring to the “Cælestial World”: “there is in reality no such thing as any Difference between *above* and *below*: The Heavens are every where *above* or *without* what they contain; but we, taking our Ideas of things from ourselves, do agree to call that *above* or *uppermost* which is over our Heads, and that *below*, which is *beneath* our Feet” (19). The narrator’s female companion is “mightily pleased” (19) with this unfamiliar juxtaposition of upper and lower, which disrupts previously held yet largely unexamined beliefs about the cosmos. Bringing together two incongruous concepts—such as upper and lower, above and below—casts ambiguity on previously stable concepts and allows the characters to imagine celestial space beyond their usual human-centered viewpoint. Harris’s female character highlights this point by claiming that “we are often so vain as to take our little narrow View or Horizon for the Bounds of all that is to be seen: and judge, that what is not within our Hemisphere, to be either nothing at all, or at least not worth our knowing or enquiring after” (20). In this instance, Harris uses contradiction to focus presence upon, and

disrupt, a human-centric understanding of astronomy while offering an alternative means of conceptualizing celestial space.

A further example of contradiction can be found in Martin's *The Young Gentleman and Lady's Philosophy* (1755-1765), when one of the characters attempts to persuade the other to discard a recalcitrant belief that the Earth rests at the center of the universe. Initially the male character, Cleonicus, tries to use verbal reasoning to convince his sister, Euphrosyne, that the Earth is not stationary and that it instead revolves around the sun. This strategy, in Martin's telling, is insufficient as Euphrosyne insists that the older theory "seems, for the most part, agreeable to the Senses, and is often mentioned in the Holy Scriptures' (1: 11). In order to challenge this common belief, Cleonicus takes Euphrosyne to a local grain mill. Curious about the excursion, Euphrosyne questions what the experience in the mill will provide in order to so thoroughly change her perception of the natural order: "But, pray, what curious *Spectacle* will there offer to confute such a general Argument?" (1: 11, emphasis mine). Euphrosyne's comment hints at the kind of demonstration that will be necessary to disrupt her accepted premise.

Cleonicus refrains from giving an immediate answer to his sister and instead instructs her to climb into the mill and experience the spectacle for herself. After a moment, in which he speaks to the miller outside, Cleonicus steps into the structure and quizzes his sister about what she sees. Responding, she claims that "I never was in one before; there is something novel and strange in the Structure, and I am greatly entertained with the Oddity of my Situation; but what amuses me most of all is the *Motion* of that large square upright Post; see, how fast it moves round!" (1: 13). Puzzling Euphrosyne even more, Cleonicus replies that "[y]ou'll be further surprised, Euphrosyne, when I tell you, though I see no Post move, I see the Mill itself move" (1:

13). Using the mill as an impromptu pedagogical instrument, Cleonicus contests his sister's senses by maintaining that the mill, and not the center post, is turning. Cleonicus explains that outside "*Rotato the Miller*" is using a "strong Lever" to turn the mill about its axis, a perspective that is verified when the sister looks out a small window. The brother then draws the analogy between his sister's perceptions in the mill, seeing "that very curious and indeed wonderful apparent Motion of the *Swivel-post*" (1: 13), and her perceptions traveling on Earth as it orbits the sun. As a result of these material contradictions, juxtaposing sight with embodied sensation, Euphrosyne expresses her surprise and claims that she now believes in both the heliocentric theory and the contingency of her sight. This spectacle is one of many that Martin uses throughout his text to disrupt common perceptions and pose new ways of conceptualizing the physical world.

Although an individual instance of excess or contradiction could be perceived as spectacular, a single instance was often not enough to constitute a spectacle or spur prolonged audience attention. For that, eighteenth-century science popularizers employed multiple repetitions and juxtapositions of excess and contradiction to produce spectacular amplification. A classical rhetorical figure, amplification refers to the "accumulation of all the parts and topics inherent in a subject, strengthening the fabric of the argument by insistence" (Longinus 27). Further accounts of the term in classical and late medieval rhetoric maintain that amplification alludes to both intensity, as in "the heightening of a theme," and copiousness (214). In the case of eighteenth-century science spectacles, I argue that science popularizers used spectacular amplification, or the combination of excess and contradiction, both within and across events, to intensify the presence of novelty, wonder, and uncertainty by dwelling upon them.

In *The Microscope Made Easy* (1742), an eighteenth-century microscope instructional text, author Henry Baker demonstrates how historical science popularizers combined multiple instances of excess and contradiction to amplify the cumulative sense of wonder and disruption. As noted by rhetorician Jordynn Jack, historical audiences often had difficulty interpreting the images produced by microscopes. The emerging technology was difficult to focus, and the images were frequently blurry when they could be seen at all. In order to assist new users, seventeenth-century scientist Robert Hooke offered, what Jack called, a “pedagogy of sight” to help users read the unfamiliar and ambiguous images produced by the instrument. In a similar fashion, eighteenth-century science popularizers like Baker also instructed their audiences on how to interpret microscopic images. As seen in *The Microscope Made Easy*, part of Baker’s “pedagogy of sight” includes encouraging users to see microscopic images as consistently wondrous, amazing, and spectacular. Baker seems less interested in teaching audiences to read a single correct image and instead urges his audiences to marvel at the microscope’s ability to foreground wonder and uncertainty. An example of Baker’s emphasis on wonder can be seen in his comparison of a mite with an elephant:

Wonder dwells not so much on Nature’s *Clocks* as on her *Watches*; and indeed, upon comparing the Structure of a *Mite* with that of an Elephant, I believe we shall concur in the same Opinion. The Largeness and Strength of the One may strike us with Wonder and Terror, but we shall find ourselves quite lost in Amazement, if we attentively examine the several minute Parts of the Other. For the Mite has more Limbs than the Elephant, each of which is furnished with Veins and Arteries, Nerves, Muscles, Tendons and Bones: it has Eyes, a Mouth, and a Proboscis too (as well as the Elephant) to take in its Food; it has a Stomach to digest it, and Intestines to carry off what is not retained for Nourishment. (xv-xvi)

Here, Baker cultivates a sense of wonder by confounding the differences between the infinitesimal and the gargantuan. Despite their drastic differences in size, Baker’s vivid description of the magnified mite shows that the tiny insect and the elephant have quite a lot in

common, including a list of similar physiological features like veins, arteries, nerves, muscles, tendons, bones, and, most notably, a proboscis. This excessive repetition of features serves as copia for Baker's claim that the mite and elephant are not as dissimilar as audiences might initially imagine. Further disrupting audiences' expectations, Baker suggests that the mite could be considered more wondrous than the elephant for it has many of the same features, or more in the case of limbs, in a much smaller body. If audiences marvel at such details in a massive animal, should they not be "quite lost in Amazement" at the accumulation of so many features in a tiny creature?

Baker, however, does not stop with a single comparison or an unambiguous answer. Instead, he continues to disrupt common beliefs about relative size through the repeated use of excess and contradiction. After encouraging audiences to be "lost in Amazement" over the numerous miniaturized features of the mite, Baker disrupts this perception by claiming that the tiny mite is itself elephantine when compared to even smaller creatures:

Let us now stop, look back, and consider as far as our Abilities can reach, the excessive Minuteness of all these Parts; and if we find them so surprizing and beyond our Ideas, what shall we say of those many Species of *Animalcules*, to whom a Mite itself, in Size, is as it were an Elephant? All these, and numberless Wonders more, the MICROSCOPE can exhibit to us. (xvi)

Positioning the mite's "excessive Minuteness" as elephantine when compared to *Animalcules* demonstrates how spectacular amplification can work by layering excess and contradiction. Whereas the previous example used multiple details to repeatedly reinforce a single contradiction, the two passages taken together present a string of contradictions that contest perceptions about relative size. What counts as small when even the tiny mite can be seen as gigantic? Is the mite more similar to the *Animalcules* or the elephant? Ultimately, Baker chooses not to provide clear answers but invites his audiences to dwell upon the pleasing uncertainties. In

the prologue to *The Microscope Made Easy*, Baker claims that one of his aims is to overcome the tendency for users to interact with the microscope once, as a “meer [sic] Play-thing...that raises our Wonder for a Moment, but is of no farther Service” (iii). Instead, he wants to instill a more far-reaching sense of wonder that will “excite in Mankind a general Desire of searching into the Wonders of Nature” (iii). The multiple contradictions found in Baker’s text highlight and then strengthen the perception that Nature is full of wonders for microscope users to explore. Through his use of spectacular amplification Baker argues that the microscope is not an instrument to be used once and then laid aside but one that can be used again and again to engender a more substantial shift in perspective. In this manner, Baker cultivates an ongoing sense of spectacle, which invites audiences to continue to use the microscope even after their first experience of wonder is over.

Eighteenth-century science spectacles further show that spectacular amplification is not limited to the objects or instruments on display. As seen in scholarship on historical spectacles, discursive and material disruptions to the surrounding scene can be just as startling. For example, in his analysis of the 1927 historical pageant commemorating the Battle of Saratoga, S. Michael Halloran demonstrates that the context of a spectacle, including the audience and the material surroundings, can become a notable feature of the event. He argues that, in his case study, the large and diffuse events of the pageant meant that audiences often had difficulty seeing or hearing the official pageant performances in their entirety. Instead, newspaper reports suggest that what most audience members “experienced with far greater intensity was beautiful autumn scenery, festively costumed people parading about, jostling crowds, the smells of damp earth, gasoline, and smokeless gunpowder, the taste of hot dogs and other picnic foods, the sounds of motorcycle sirens, rifle and cannon fire, squawking loudspeakers, crying children” (12). Halloran

argues that “the lived experience of those present overwhelmed the text” of the pageant, “like a dramatic performance at which the splendor and animation of those in the audience attracts more attention than the doings on stage, transforming the play into a side-show entertainment” (6-7). Extending Halloran’s position, I argue that the “lived experience” of spectacle contexts could provide opportunities to cultivate spectacular amplification. Pushing the influence of context even further, Wendy Hesford maintains that spectacles are not isolated rhetorical incidents but are understood and interpreted through audience members’ experiences with other contexts. Hesford’s contention that we read spectacles “intercontextually” also suggests that we pay attention to disruptions that interrupt audience expectations created across extended contexts, such as widespread cultural conventions like decorum or appropriate gendered behavior.

Eighteenth-century science popularizers understood the disruptive potential available in the extended scenes of their science displays. As seen in the previous examples, eighteenth-century science popularizers frequently used dialogues or narrative genres that showed fictional characters engaging with scientific instruments in a variety of settings. These fictional characters modeled appropriate scientific practices and provided audiences with a sense of how new or emerging technologies could be integrated within existing practices and social structures. In an effort to promote recreational science as a suitable and engaging activity for diverse audiences, eighteenth-century science popularizers would often include female characters in their dialogues. These female characters acted primarily as audiences for the science displays orchestrated by male characters. On occasion, however, the female characters from the audience were invited to take a more active role in the display. In these moments, the female characters’ appearances and actions were foregrounded in a way that disrupted accepted notions of gender and thus added to the spectacle of the science display.

An example of a female character becoming part of the scientific inquiry, and thus contributing to the spectacular amplification of the display, occurs in an English translation of Francesco Algarotti's *Sir Isaac Newton's Philosophy Explain'd For The Use of Ladies. In Six Dialogues on Light and Colours* (1739). This text includes fictional scenes in which a male narrator offers scientific lessons to a female Marchioness. Describing the use of a microscope in one scene, the narrator invites the female character to imagine what her hands would look like if viewed under a microscope:

You think, for Instance, that your Hands which have been the Subject of so many fine Verses, are smooth and polish'd; and possibly might be greatly offended, if any one should dare to dispute them this Quality. And yet if you were to look upon them through a Microscope, you would be surprized to see a great Number of Pores that separate the Texture of them, and to find that they are cover'd with Scales like those of a Fish. You would discover in them Cavities [sic], Promontories; Valleys and Hills, for the Abode of a Nation of little Animals, who perhaps spend their Life there. And to increase your Wonder, you would be presented with the Sight of Rivers and Seas. In short, you would be obliged to confess that they are very different from those which your Poets described. (78-79)

In this passage, the author includes a mixture of excess and contradiction to exaggerate the disruption produced by an imagined microscope. Using numerous details, the narrator repeatedly emphasizes the contradiction between smooth and irregular skin by arguing that the seemingly "polish'd" skin is, when magnified, actually marked by a number of disturbing imperfections such as pores, scales, cavities, valleys, seas, and even creatures. This contradiction is further amplified—"to increase your Wonder"—by the narrator's appeal to gendered expectations for women's beauty. Contrary to the claims of poetry, the narrator contends that the imagined microscope exposes the Marchioness's skin to be grotesque instead of beautiful. Arguably a magnified image of the male narrator's hand would reveal similar defects; however, by utilizing accepted beliefs about women's beauty, the narrator intensifies the display's collective sense of disruption. Rather than simply exposing smooth skin to be marred with rough features, the



narrator heightens the disturbance by contrasting verse-worthy beauty with a repulsive appearance.

Other examples from public science narratives demonstrate how disruptions of audience decorum could intensify the collective sense of wonder. In *The Newtonian System of Philosophy Adapted to the Capacities of Young Gentleman and Ladies, and Familiarized and Made Entertaining by Objects With Which They Are Intimately Acquainted: Being the Substance of Six Lectures Read to the Lilliputian Society, by Tom Telescope* (1761), authored by John Newberry, the young male narrator Tom Telescope relies on disturbances to accepted gendered behavior to increase the novelty of his science demonstrations. During one of his lectures, Tom Telescope attempts to persuade his fictional audience, which includes other children as well adults like the Duke of Galaxy and the Countess of Twilight, of the “wonderful effects” of the elasticity of the air. This relatively abstract principle is initially unconvincing, and one of the little girls in the audience asks for a demonstration: “But before you proceed farther, says Lady *Caroline*, pray do me the favour, Sir, to convince me, by some experiment that the air is endowed with this wonderful quality” (39). Agreeing to her request, the narrator asks Lady Caroline to assist him with the display of a toy gun. After requesting that she “step this way,” the narrator asks the young girl to operate a “Pop-gun,” which shoots a small pellet through the air (39):

You see here is a pellet in the top of this tube, made of hemp or brown paper. With this piece of paper we will make another pellet, and put into the other end. Now with the gun-stick drive it forward. There, you have forced the pellet some part of the way with ease, but it will be more difficult to get it farther, because the air, being compressed, and made more dense or compact will make more resistance; and when you have pressed it so close that its force overpowers the resistance which the pellet makes at the other end, that pellet will fly off with a bounce, and be thrown by the spring of the air to a considerable distance.---There, see with what force it is thrown. (39)

Tom Telescope further explains that the scientific properties of the toy gun are not often remarked upon because “it is a school boy’s action, and is seen every day; for indeed, we seldom

trouble ourselves to reason about things that are so familiar” (40). Thus, in an effort to get the audience to appreciate the “wonderful quality” of the scientific principle that produces this common sight, the narrator disrupts expected gendered behavior by having a little girl perform the “school boy’s action.” This novel inclusion, adding a little girl to the audience’s usual perception of a toy gun, disturbs the common scene enough for the audience to attend to the scientific principle that governs the previously overlooked sight. After Lady Caroline’s demonstration, the narrator remarks: “you seem all amazed, and I don’t wonder at it, since you have never yet considered the extraordinary properties of this element; and it must seem strange to you that the air, which is so necessary for life that without it we cannot breathe, should be tortured into an instrument of destruction” (40-41). In Tom Telescope’s account, the audience has finally recognized the “extraordinary properties of this element” with the help of Lady Caroline’s gender-disrupting demonstration. Moreover, once the audience pays attention to the previously unnoted mechanism of the pop-gun, the narrator maintains that they can also recognize an additional contradiction produced by the demonstration—that the qualities of the air can enable life-giving breathe as well as facilitate “instrument[s] of destruction.”

Similarly relying on disruptions to gendered expectations, Tom Telescope again uses Lady Caroline to elucidate a point about the spring in the air. Discussing the qualities of the air in more detail, Lady Caroline expresses a concern that if the air lost its spring she would have trouble breathing. Responding to her fears, Tom Telescope answers, “if your Ladyship finds the air so disposed, you should make use of the instrument that lies by you, which, by putting the air in motion, will in part recover its spring” (47). Confused by his comment, she further questions the narrator: “What instrument, Sir? Says the Lady. Your fan, Madam, returned the Philosopher. Every fan is a philosophical instrument, and was originally contrived, we may suppose, for the

purpose above-mentioned” (47-48). This example presents another case of the narrator disrupting the gendering of common objects. By having the fictional Lady Caroline operate a schoolboy’s toy gun and relabeling her decorative fan a “philosophical instrument,” the narrator counters expectations for women’s engagement with gendered material objects. These contradictions draw audience attention to scientific principles that are abstract and difficult to visualize, like the spring in the air, and encourage audiences to dwell on the wonder, amazement, and spectacle of previously unnotable events, like the pop-gun or the common fan. These examples show that disruptions to gender can be used to amplify the unfamiliarity surrounding a science spectacle or, at times, create the initial presence necessary to reconsider commonplace objects, perceptions, and beliefs about the natural world.

### **Anticipating Women’s Responses**

By inviting audiences to consider the extended context of scientific demonstrations, science popularizers began introducing questions about how science should intersect with matters of public concern. In the example of Tom Telescope’s dialogue, the inclusion of Lady Caroline made the previously unnoted mechanism of the pop-gun suddenly visible. But how did the little girl’s inclusion in a scientific demonstration mediate audience conceptions about science and gender? Did such a demonstration suggest that science was an appropriate past time for aristocratic children, regardless of gender? Did the display disrupt the prior gendering of objects like the pop-gun and suggest that young ladies could use masculine objects for scientific pursuits? I argue that, especially when calling upon gender and other cultural expectations to amplify the spectacle of science demonstrations, science popularizers prompted audiences to reflect upon accepted material *and* social premises.

Within their dialogues, science popularizers acknowledged that their female characters were modeling new educational practices and that these practices would complicate existing notions of appropriate gendered behavior. In James Ferguson's *The Young Gentleman and Lady's Astronomy, familiarly explained in ten dialogues between Neander and Eudisia* (1768), for example, the fictional characters discuss the implications for women's science education. The male narrator Neander and his sister Eudisia are quick to point out that learning astronomy will benefit women's traditional gender roles. The characters claim that knowledge of astronomy will not make women vain or arrogant but will rather instill a sense of humility at God's creation. To this end, they argue that the subject of astronomy is "the best for enlarging our minds, and filling them with the most noble ideas of the GREAT CREATOR and his works; and consequently of drawing us nearer to Him, with an humble sense of our own meanness" (2). Ferguson's characters further claim that astronomical study will provide ladies with "a rational way of spending their time at home" and would decrease their "taste for the too common and expensive ways of murdering it, by going abroad to card-tables, balls, and plays" (45). According to Ferguson's text, it is "commonsense" that women's scientific study should make them "much better wives, mothers, and mistresses" (45).

The advances in women's science education and their subsequent shifts in behavior were not without their complications, however. In one passage, Eudisia laments that she cannot attend a university like her brother to learn more about astronomy. Neander responds, "I have the pleasure of being acquainted with many ladies who think as you do. But if fathers would do justice to their daughters, brothers to their sisters, and husbands to their wives, there would be no occasion for an university for the ladies; because if those could not instruct these themselves, they might find others who could" (45). This passage suggests that Ferguson understood that

shifts in women's educational practices could raise questions about existing educational systems, like the accepted premise that university education was only for young men of a certain social standing. Although Ferguson swiftly denies the need for a ladies university, he does place the onus for women's science education on their male relatives, perhaps signaling a change in familial responsibilities and in the ways that male and female family members should interact with each other.

Ferguson additionally addresses how increased scientific knowledge might complicate women's social engagements outside of the family. In one scene, Eudisia and Neander discuss the propriety of her including astronomical information in polite conversation. In this example, Eudisia had just returned from a three-day stay with the neighboring Goodall family and Neander asks whether she had discussed their ongoing astronomical conversations with that family. Neander comments that "Mr. Goodall and I spent an hour together last night: and though he was full of his praises of your good sense, he did not say one word about our astronomical conversations; by which, I imagine, you spoke nothing about them in that family. Yet I am far from doubting, that it would have been very agreeable if you had" (53-54). Eudisia responds, "Truly, brother, if I had, you must have heard of it: and then I should not have wondered if you had said that I am not over-stocked with good sense. I must know these things better before I begin to speak of them; and even then, not to speak, unless I am desired by those to whom I think the subject will be entertaining" (54).<sup>23</sup> These scenes hint at the disruptions that women's

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<sup>23</sup> Another wonderful example of how increased scientific education might mediate women's relationships with men occurs in Benjamin Martin's *The Young Gentleman and Lady's Philosophy* (1755-1765). Here, the sister character Euphrosyne asks her brother Cleonicus for examples of other women learning about natural philosophy. Cleonicus responds with a tale about two women, one with access to skills and education and the other without: "I shall mention in Particular *Euprepia*, a younger Daughter of *Eugenius*, to whom Nature has not been more indulgent in *Genius*, and fine Parts, than her Father has been careful in bestowing on her a liberal and genteel Education, and she herself sedulous to improve both; so that she is now not more conspicuous for personal Charms and Beauty, than great and amiable for her singular good Sense and Judgment, in natural Sciences especially; on which Account she is admired, esteemed and beloved by all Gentlemen of Discernment. This fine Lady, you will easily judge, must be a

scientific education could pose to accepted gendered roles, identities, and relationships within the eighteenth century.

These scenes from public science texts, however, only present the perspectives of science popularizers and their suggestions for how women might take up scientific study and negotiate its disruptive, spectacular possibilities. But how were such suggestions received? How did historical female audiences choose to learn about science and how did they display their unfamiliar knowledge in public settings? In the next chapter, I investigate how eighteenth-century women responded to the invitation to take up scientific study. I explore how women negotiated the spectacle of their scientific learning and variously used their scientific knowledge to mediate existing social relationships and advocate for their preferred forms of appropriate social behavior.

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notable Contrast to *Thelia* Daughter of *Philargus*, who, being of a sordid and contracted Temper, has bestowed no more Education on his Daughter than Marking and making of Pasties; thus *Thelia* lives admired by yeomanly Boors” (1: 2).

## POLITE SCIENCE AND THE SPECTACLE OF WOMEN'S LEARNING



Figure 5: *Beauty in Search of Knowledge* (1782)

One of the most famous examples of eighteenth-century women's science education is documented in the personal correspondence of Benjamin Franklin and Mary "Polly" Stevenson. While acting as a Pennsylvania colonial agent living in London, Franklin resided intermittently at No. 7 Craven Street, and over the course of his nearly fifteen-year stay he developed a warm relationship with both his landlady Mrs. Margaret Stevenson and her daughter Polly. After

meeting the fifty-one year old Franklin when she was nineteen, Polly Stevenson became a frequent correspondent and close friend of the famous statesman and scientist, exchanging numerous letters with him and eventually becoming his neighbor in America when she, then a widow, moved to Philadelphia with her children (Stifler 15-16).

Within their long-standing correspondence, we find a record of Stevenson's introduction to natural and moral philosophy and gain insight into ambivalent eighteenth-century attitudes towards women's scientific education and practices. Like the female characters in the popular science dialogues seen in chapter one, Stevenson is depicted as a bright young woman who initiates her own scientific education with the assistance of a close male acquaintance or relative. Similarly, Franklin encourages Stevenson in her studies, even suggesting that this instruction will enhance her already pleasing manner. In one of the more frequently cited passages of their correspondence, Franklin teasingly asks Stevenson why she wishes to pursue scientific studies: "But why will you, by the cultivation of your mind, make yourself still more amiable, and a more desirable companion for a man of understanding, when you are determin'd, as I hear, to live single?" (May 1, 1760).<sup>24</sup> Franklin's comment provides an example of how eighteenth-century scientists and popularizers often argued that women's scientific education could benefit their conventional roles and practices, in this case the role of polite conversationalist and charming companion for a learned gentlemen.

Because of the ascribed purpose of polite activity in the mid-eighteenth century—specifically the individual and social benefits of polite conversation—women were encouraged to educate themselves and display this knowledge in order to fulfill their socially sanctioned role

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<sup>24</sup>Franklin and Stevenson's correspondence can be found in James Madison Stifler's *"My Dear Girl": The Correspondence of Benjamin Franklin with Polly Stevenson, Georgiana and Catherine Shipley* (1927).



as participants in polite conversation. However, this recommendation was not *carte blanche*, as Franklin warned Stevenson:

There is, however, a prudent moderation to be used in studies of this kind. The knowledge of nature may be ornamental, and it may be useful; but if, to attain an eminence in that, we neglect the knowledge and practice of essential duties, we deserve reprehension. For there is no rank in natural knowledge of equal dignity and importance with that of being a good parent, a good child, a good husband or wife, a good neighbour or friend, a good subject or citizen, that is, in short, a good Christian. (June 11, 1760)

While the study and practice of natural philosophy was said to complement women's social roles and responsibilities, being both ornamental and useful, there was a simultaneous concern that such studies could be taken too far, thus negating the intended social benefit. In this manner, women were encouraged to learn but not to excess and only for specific purposes that benefitted existing roles and practices.

Although the concern about being too pedantic existed in all women's uses of science, this issue was particularly problematic in polite social settings because of the conflicting advice circulating about women's uses and displays of scientific knowledge in these venues. While most eighteenth-century sources agreed in principle that women should not take their scientific studies too seriously, there was a lack of consensus about everyday practices and concrete boundaries for polite displays of scientific knowledge. In such spaces women were certainly bound by generally accepted and highly recalcitrant notions of decorum and appropriate gendered behavior, which restricted their access to education and their ability to speak freely; however, in polite spaces women also encountered the somewhat contradictory notion that polite interaction required women to engage in intellectual, engaging, and amusing conversation for the benefit and instruction of others.

With the increased freedom to use and display knowledge, scientific and otherwise, perhaps it is not surprising that educated women often became the most intriguing spectacle

during polite interactions, displaying a level of intellectual competence previously unseen or imagined. Even Franklin was, at times, startled by Stevenson's grasp of scientific material and her creativity when thinking about scientific puzzles, which she was at liberty to display in her polite letters to the scientist. In one example, Stevenson asks Franklin's opinion about a second-hand story in which water pumped from a well was initially cold and then became warm after vigorous pumping. Franklin, discussing the story with Stevenson, initially doubts its veracity. However, he then shifts his opinion and expresses admiration once he hears Stevenson's explanation of the phenomenon: "Supposing the fact, that the water of the well at Bristol is warmer after some time pumping, I think your manner of accounting for that increas'd warmth very ingenious and probable. It did not occur to me, and therefore I doubted of the fact" (March 30, 1761).<sup>25</sup>

Although Stevenson's letters to Franklin represent one of the more famous intellectual and polite social exchanges of the eighteenth century, additional published accounts, diaries, and letters provide further insight into how women understood and managed the contradictory dictates that ordered their social spaces. In particular, this chapter examines accounts of published authors like Hester Chapone, diarists such as Mary Hamilton, as well as members of the bluestockings circle, a group of women and men well known for their intellectual assemblies. Although the famous eighteenth-century bluestocking conversational circle discussed a wide variety of topics, including literature, arts, history, and even politics, less attention has been paid to how subjects of natural philosophy and natural history were incorporated within this banquet

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<sup>25</sup>Polly Stevenson's solution, if you are curious, is as follows: "If it is a fact that the water which was in the well is warmer after they have pumped for some time, I should account for it in this manner: the water, I imagine, springs warm, but being kept long in the well grows cold; after they have pumped some time, the water which was in the well is exhausted, and what they then pump is fresh from the spring. This, I apprehend, may be the cause of the water's being warmer after they have drawn a great quantity. It is, I own, great assurance in me to say so much, but I hope it will not offend my dear and honoured friend" (Sept. 16, 1760). In this last line, we can see an example of the cautious tone and wording that ladies often employed when demonstrating their scientific acumen.

of ideas. Within the eighteenth century milieu, with demonstrations and books describing the wondrous rethinking of the natural world, natural philosophy and natural history provided a topic of conversation that fit well with the assemblies' professed goals of education and amusement.

This chapter examines how these and other women advanced the possibility of women's polite engagement with science while restricted by societal, spatial, *and* self-imposed strictures against appearing too educated. Notably, the historical women discussed in this chapter utilized scientific displays as rhetorical tools for mediating polite social interaction. Women like bluestockings Elizabeth Montagu and Hannah More conversed about scientific topics and displayed curious scientific objects in order to advocate for their preferred versions of polite, social behavior in assemblies, drawing rooms, and salons. Although these women had distinct visions for how they thought polite, public, and heterosocial groups should behave, they each relied on science spectacles to draw presence to and reify their ideal forms of social interaction. Thus, eighteenth-century women can be seen to employ polite scientific displays for public ends, using science spectacles to shape polite public interaction.

Scientific spectacles became complicated, however, when women offered themselves as part of the display, showcasing their scientific interest and knowledge in order to advocate for particular social interactions. In this chapter, I investigate how eighteenth-century women, particularly those associated with the bluestocking conversational circle, navigated the boundaries of appropriate behavior to display their scientific knowledge. I argue that women engaged in strategic forms of rhetorical presence and absence to alternatively direct and deflect attention to their uses of scientific language, embodied practice, and object displays. Through their selective deployment of science spectacles, eighteenth-century women negotiated the

spectacle of their scientific learning and worked to redefine, and at times reinscribe, what counted as an extraordinary display of women's education.

### **Women and Polite Spaces**

Rhetorical scholars such as Charles Bazerman have investigated how new technologies, practices, and scientific meanings emerge and circulate within existing discursive fields. Although such objects and knowledge are initially positioned as fitting within the norms and pieties of various discursive spaces, such additions can often cause their own ripples within both the original and adjacent discursive fields. In the eighteenth century, popularizers attempting to integrate science into polite spaces similarly suggested that new scientific theories and technologies would benefit the existing practices and goals of polite space, such as education, amusement, and harmonious conversation between diverse groups.<sup>26</sup> However, this integration was not without its own disruptions and tensions. With the growing popularity of new scientific ideas and demonstrations, men and women began debating the appropriateness of women's scientific knowledge—which was generally accepted—and the parameters of how women should subsequently use and display this knowledge—a much more contentious issue that did not provide easy agreements. These debates, found within letters, diary accounts, and published advice books, show how emerging scientific ideas and technologies foregrounded and at times augmented the tensions about women's roles and practices within polite society. Science was posed as something that could mediate polite social relationships, but its inclusion into polite spaces also kindled debates about the very nature and substance of those relationships.

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<sup>26</sup>Eighteenth-century connections between politeness and public engagement are further described by historian Lawrence Klein: "The Whig cultural ideologists of the early eighteenth century used politeness to construct a notion of the public sphere. Their public sphere was a public discourse suitable as a vehicle for the clarification of public matters and the advancement of public morals as expressed in economic and political life, in religion and in arts and letters. Politeness was relevant to this undertaking as both end and means. First, politeness was the term that described the outcome of public discourse, the gradual refinement and improvement of society. Second, politeness was the term that described the disciplines requisite for public discourse, a set of discursive norms for the operation of discourse" ("Gender, Conversation and the Public Sphere" 108).

Eighteenth-century England has been characterized as a time in which women experienced an increased presence and influence within the public sphere. Much critical attention has been paid to the social conditions of the eighteenth-century public sphere, most notably by Jürgen Habermas who singled out this period for having particularly robust public debates about moral, cultural, and political issues that existed outside of domestic and state purviews. While Habermas mainly focused on “masculine” public spaces like the coffee-shop, or overlooked the numerous women who operated within such spaces,<sup>27</sup> recent scholars have been quick to add detail to our understanding of eighteenth-century public spaces, including the public presence and influence of women. Numerous scholars have pointed out the increased numbers of women readers and writers during this period, citing the gains women made in publishing and print culture.<sup>28</sup> However, historian Lawrence Klein argues that this represents only a small portion of women’s public activities, claiming “though literary historians have done much to recover the identities of women writers, a cultural history delineating women’s roles not just as writers but as brokers, networkers, patrons and consumers has yet to be written” (101). One area, in particular, that Klein and other scholars have investigated in their ongoing efforts to delineate women’s involvement and influence in the public sphere is their role as mediators of polite conversation.<sup>29</sup>

Eighteenth-century English polite culture has its roots in French salon and aristocratic court culture and derived many of its tenets from this antecedent and parallel tradition. Although

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<sup>27</sup>Markman Ellis discusses how women were included with the “masculine” space of the coffeeshop in “Coffee-women, ‘The Spectator’ and the Public Sphere in Early Eighteenth Century.”

<sup>28</sup>Women’s publishing and print culture is detailed in *Women, Writing and the Public Sphere, 1700-1830*, edited by Elizabeth Eger, Charlotte Grant, Cliona O Callchoir, and Penny Warburton.

<sup>29</sup>Elizabeth Eger claims that women authors and conversationalists could flourish amidst the diversity of eighteenth-century public culture: “Such a demotic and diffuse Enlightenment, which incorporated journalists, Johnsonian coffee-house philosophers, writers of the bluestocking circle, Unitarian ministers, collectors and connoisseurs, scientists and educators, as well as moral philosophers such as Shaftesbury, Hume and Adam Smith, was a world in which women along with intellectual iconoclasts of all sorts, could participate and even flourish. Their presence provoked interest in itself, the ‘woman question,’ occupying pens in all sectors of contemporary culture, from political and aesthetic treatises to new encyclopedias and journals” (Eger 27-28).

it is important to acknowledge that differences between the English and French traditions certainly existed, English notions of civility and civil conversation were nevertheless shaped by the tenets and practices cultivated in French salons during the seventeenth and early eighteenth century. Indeed, it is difficult to understand the emerging English public sphere, with its emphasis on conversation, politeness, and the cultivation of manners and taste, without referencing the cultural influence of England's continental neighbor. In particular, Klein has pointed to the values of "equality, reciprocity and freedom, which according to Habermas, were constitutive of the [English] eighteenth-century public sphere" as derived in part from the influence of the French salon tradition (103). In addition to providing ideological roots that enabled the widespread, rational civic debates that characterized England in the eighteenth century, the influence of French salon culture also opened doors for women's increased involvement in public affairs and polite spaces.

The French salon tradition is well known for the inclusion of intelligent and charming women like Madame Scudéry, a prolific writer and rhetorical theorist. In her writings Scudéry outlines both appropriate conversational and letter-writing practices for women and further argues for the importance of conversational spaces, contending that salons and the conversations undertaken within them can rival traditional civic places and public discourses for social and political power (Donawerth 23-29). Although Scudéry is careful to remind women to perform conventional gender roles, their inclusion within such powerful spaces presents new opportunities for early modern and eighteenth-century women to participate in public affairs. Indeed, theorists of the French salon even argue that women were necessary and vital for such spaces, contending that women helped facilitate the conversational balance needed to refine and display polished manners and moral sentiments.

An example of the importance placed on women's involvement in social spaces can be seen in the writings of Charles de Marguetel de Saint Denis, sieur de Saint-Evremond (1613-1703), a French courtier who took up permanent residence in London in 1670. In these works, which were translated from French into English during the early eighteenth century, Saint-Evremond claimed that women created a necessary balance in polite conversation, which men's conversation alone could not provide. Explaining the purposes of polite conversation, Saint-Evremond wrote: "The most essential Point is to acquire a true Judgment, and a pure Understanding. Nature prepares us for it, but Experience and Conversation with polite Persons, brings it to Perfection" (170). Saint-Evremond contends that the principle goals of civility—"true Judgment" and "pure Understanding"—require both an active and astute reason as well as the willingness to pursue additional experience and the sociability to engage with others, developing natural talent through mutual interactions. In order to achieve such mutually beneficial conversation, both sexes were deemed necessary: "It was argued that, while the discussion among women on their own was too shallow, the discussion among men on their own was too unsocial, whether because it wound down into pedantic concern with detail or because it exploded into an uncontrolled storm of controversy" (Klein 105). For this reason, Klein argues that "[t]he presence of both sexes was required to nurture a conversation that was both substantive and sociable—polite conversation, in short" (Klein 105). In this manner, women's inclusion in polite conversation was said to balance out the negative qualities of men's conversation such as aggression, rudeness, and pedantry while simultaneously providing qualities missing from men's homosocial interactions. Certainly essentializing, Saint-Evremond's writing contends that women's natural sweetness, gaiety, and sociability are necessary components of polite conversation and the cultivation of polite virtues. We can thus

see how women were viewed as the mediators or agents of polite social interaction, their presence theoretically changing the rhetorical situation in ways that prompted certain preferred behaviors and brought certain personal qualities to the fore.

Notably, there is also a component of rhetorical display and performance within predominant notions of polite conversation. If women were theoretically helping those around them acquire “true Judgment” and “pure Understanding,” they were performing an additional service of helping conversationalists display or perform these qualities to larger society. When polite conversation was working as it should—combining both rational discussions and sociable engagements—such discourse made “virtues visible, accessible and beneficial to others” (Klein 107). A frequently used commonplace described natural talent and unknown virtue as unpolished ore, internal substance that needed both refinement and surface shine. The anonymous female author of *An Essay in Defence of the Female Sex* (1696) uses this metaphor to explain the value of politeness and conversational skills:

‘Tis true a Man may be an Honest and Understanding Man, without any of these Qualifications; but he can hardly be a Polite, a Well Bred, and Agreeable [sic], Talking Man, without all, or most of these. Without ‘em, *Honesty*, *Courage*, or *Wit*, are like Rough *Diamonds*, or *Gold* in the *Ore*, they have their intrinsick Value, and Worth, before, but they are doubtful and obscure, till they are polish’d, refin’d, and receive *Lustre*, and *Esteem* from these. (Lady 123)

The anonymous female author also adds that women versed in polite behavior and conversation were particularly adept at helping men achieve social polish: “There are other Qualifications, which are as indispensably necessary to a Gentleman, or any Man that wou’d appear to Advantage in the World, which are attainable only by Company and Conversation, and chiefly by ours” (Lady 23-24).<sup>30</sup> Thus polite conversation and interaction leads not only to the

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<sup>30</sup>Klein notes that such arguments could position women as subservient, as “agents of politeness” that serve to civilize men. While some of this certainly happens, Klein is also quick to point out the mutuality of conversation, which relies on both men and women’s contributions to function appropriately: “in a world that was being



development of intrinsic worth but also enables such worth to “appear to Advantage in the World,” with women serving as facilitators for such displays and performances of politeness.

It was into this polite realm that popularizers and proponents of early science attempted to position the new philosophy. In 1714 Richard Steele wrote an essay to promote the recently invented orrery, a mechanized model of the solar system, by describing “not only the didactic value of the device, but also its social function” (Walters 121). Linking the device to both the instructional and amusing components of polite interaction, Steele contends that for the purchasers of the orrery “[t]his one engine would open a new Scene to their Imaginations; and a whole Train of useful Inferences concerning the Weather and the Seasons, which are now from Stupidity the Subjects of Discourse, would raise a pleasing, an obvious, an useful, and an elegant Conversation” (*The Englishman* 84). Steele’s claim that scientific objects could serve as polite conversational aids was adopted and augmented by numerous popularizers, lecturers, authors, and instrument makers who followed suit in connecting their scientific products with polite performance and culture. Characterizing this proliferation of polite science rhetoric in the eighteenth century, science historian Alice Walters argues that

Just as scientific lectures became a fashionable forum for polite science, so too commodities—including books, pamphlets, magazine articles, and especially instruments, in many cases produced by the same men who travelled the lecture circuit—were made to appeal to the polite. These scientific media adapted the social agendas of the polite by promoting familiarity with natural philosophy, astronomy, and other scientific disciplines as a legitimate, socially ornamental, and even necessary accomplishment. The pursuit of polite science was thus presented as complementary to the pursuit of politeness itself. (123)

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constructed around the touchstone of refined sociability or politeness, women had an assured place. Of course, it might be argued that the role assigned to women in a passage such as this was quite ancillary, serving as a catalyst to male self-actualisation. However, the emphasis on the complementarity of the sexes suggests, first, that the relation of men and women was mutually beneficial and, second, that the ultimate beneficiary of complementary male/female relations was the public sphere itself” (“Gender, Conversation and the Public Sphere” 111).

This contention, connecting the “pursuit of polite science” with the “pursuit of politeness itself” was not limited to those who sold scientific media and commodities. Foundational figures of eighteenth-century science also echoed the claims that scientific objects and knowledge would be socially advantageous, especially to young women, as seen in the Franklin’s correspondence with Polly Stevenson and Erasmus Darwin’s approval of scientific subjects for young women in *A Plan for the Conduct of Female Education, in Boarding Schools, Private Families, and Public Seminaries* (1798).<sup>31</sup>

Although the move to link new scientific knowledge and technologies with polite culture was by and large successful, it nevertheless faced skepticism and criticism from those who questioned the more grandiose claims surrounding the social benefits of women’s scientific education and found fault with some women’s behavior when discussing scientific topics. Most accepted the initial suggestion that women could take up the study of natural philosophy—deemed an appropriate subject for women due to its religious ties and its distance from traditionally masculine studies such as classical languages—instead it was the question of how far women should take this new enterprise and what social benefits women could realistically expect and facilitate through their learning. A critique of women’s over-learning occurs within Charlotte Lennox’s magazine *Ladies Museum* (1760-1761), which suggests that young women were trying, often unsuccessfully, to use polite learning to advance their social standing:

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<sup>31</sup>In *A Plan for the Conduct of Female Education, in Boarding Schools, Private Families, and Public Seminaries* (1798), Erasmus Darwin recommends additional science courses for advanced female students as a means to provide amusement and improve conversational skills: “there are other sciences, an outline of which might be taught to young ladies of the higher classes of the school, or more inquiring minds, before or after they leave school; which might not only afford them present amusement, but might enable them at any future time to prosecute any of them further, if inclination and opportunity should coincide; and, by enlarging their sphere of taste and knowledge, would occasion them to be interested in the conversation of a greater number and of more ingenious men, and to interest them by their own conversation in return” (55). Although this passage highlights the intrinsic rewards for studying natural philosophy—amusement and the possibility of further study—it also voices the common belief in the extrinsic rewards of science education. Here, Darwin suggests that women could benefit socially from science education, “enlarging their sphere of taste and knowledge,” which had the very practical effect of enabling women to better understand and converse with scientifically minded men.

many misses are instructed in accomplishments evidently above their rank, but in order to obtain a station in life to which they could not reasonably aspire. In truth, it is more the vanity of being thought to possess such accomplishments than any pleasure arising from those attainments, that is the inducement to pursue them. I have been assured by the parents of many young ladies, that their daughters were perfect mistresses of French, musick, &c. when upon a better acquaintance, I plainly perceived, they had been at much expence [sic] only to say they had been learners. (1: 172)<sup>32</sup>

In addition to vanity and overstepping one's social position, it was also worried that women's overindulgence in learning, including scientific learning, would lead to boisterous and unsocial behavior. A particular fear was that women would correct men in polite conversation and make them feel uncomfortable with their advanced knowledge about a particular topic. Such conduct would upset established gendered roles, whereby women would bring masculine faults such as arrogance or pedantry into conversation rather than balancing these tendencies in the men around them.

Thus, while women were encouraged to display their scientific knowledge, both for individual and communal benefit, taking this directive too far could turn women into ridiculous or, at times, monstrous spectacles. Author Maria Edgeworth captures this predicament in one of her parodic essays in which a fictitious male narrator advises his neighbor against overly educating his daughter. Expressing his distaste for too-knowledgeable women, the narrator exclaims: "I cannot say that I have been much enraptured either on a first view or on a closer inspection with female prodigies. Prodigies are scarcely less offensive to my taste than monsters" (3). As seen in this passage, when taken past acceptable forms of gendered behavior, women's displays of intellect and knowledge could become spectacular, as novel and unsettling as any scientific curio.

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<sup>32</sup>The identity of the responder is ultimately unknown. This could represent an actual reader comment or it could be Lennox writing through a pseudonym.

## **“Air Balloons [and] ye Marriages talk’d of particularly”: How Women Used Scientific Spectacles to Facilitate Politeness and Mediate Polite Social Spaces**

In a diary entry for August 12<sup>th</sup>, 1784, Mary Hamilton—a young diarist who documented her frequent encounters with older members of the famous bluestocking circle—describes a polite social engagement: “Mrs Delany with Mrs Sandford and her eldest son came for me we took an airing to Kensington and at 7 got to St. James’s Place. Lady Bate came to tea—Air Balloons [and] ye Marriages talk’d of particularly.” Through her diaries, Mary Hamilton—an avid chronicler of her own social engagements—provides us with insights into the ways that scientific topics entered polite conversation during the late eighteenth century. As suggested in this passage, natural philosophy and natural history were just a few of the many subjects suitable for polite conversation. The talk of natural phenomena and technological marvels blended with discussion of marriages and courtships, opinions about literature and art, moral dictates and the latest scandal. Within published essays, letters, and diary accounts we can further see how historical women utilized scientific information in their roles as mediators of polite conversation. Historical women, such as those in the bluestocking circle, used discussions of volcanoes, air balloons, insects, geography, and other natural and technological wonders to encourage congenial and harmonious social occasions that could entertain, amuse, and educate themselves as well as their fellow conversationalists.

The following section specifically attends to the ways that eighteenth-century women used the spectacular qualities of scientific topics and objects to mediate politeness and polite social spaces. Through their rhetorical choices, women employed science spectacles to enhance their own displays of politeness, to argue for their preferred versions of politeness and gendered performance, and, finally, to promote community by engaging others in beneficial display. As befitted polite conversation, however, women were also aware that their visible interest in

science could be labeled as vain or pedantic by observers. We thus see eighteenth-century women mitigating potential negative responses to their displays by engaging in rhetorical strategies of presence and absence. Rhetorician Lawrence Prelli has argued that displays function through a “dynamic between revealing and concealing” (2), suggesting that “whatever is revealed through display simultaneously conceals alternative possibilities” (2). What displays ultimately “make manifest or appear is the culmination of selective processes that constrain the range of possible meanings available to those who encounter them” (2).<sup>33</sup> We can similarly see eighteenth-century women engaging in a selective process about what to make manifest and what to let recede into a display’s background. In moments when women were advocating for behavior that fell within the boundaries of polite propriety, we can see spectacular displays of scientific knowledge or curios that blatantly sought out audience attention. In other moments, however, when women drew close to conventional ambiguities or borders, a different use of spectacular rhetoric can be seen. Rather than sharply drawing the eye, instead we can see examples of how women deployed, and advised other women to deploy, a cultivated absence. Displays of absence still sought audience attention, but they nevertheless allowed certain features—such as women’s unconventional behavior—to recede from view, visible at the edges but not the primary focus of the display. In this manner, eighteenth-century women used science spectacles to both direct and deflect public attention to certain aspects of the polite social encounter.

### *Directing Presence*

Eighteenth-century notions of polite culture sanctioned women’s role as mediators of polite culture; and the bluestocking assemblies provided perhaps the most famous example of eighteenth-century women polishing their learning, manners, and taste through polite

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<sup>33</sup>Prelli contends that the contingency in what is made manifest constitutes a “display’s rhetorical dimension” (2).

conversation and display. Starting in the mid-eighteenth century, women such as Elizabeth Montagu and Elizabeth Vesey began hosting polite, heterosocial assemblies that gathered together some of the country's most famous intellectuals, artists, authors, and politicians. Describing the sheer variety of people who attended bluestocking gatherings, Lady Stuart detailed those who made up Elizabeth Montagu's conversational circle, including: "authors, critics, artists, orators, lawyers and clergy of high reputation; she graciously received and protected all their minor brethren, who paid court to her; she attracted all tourist and travelers; she made entertainment for all ambassadors, especially men of letters" (Johnson 256). Leading intellectual figures like Samuel Johnson and Benjamin Stillingfleet also visited the bluestocking drawing rooms and praised the group publically, attesting to the wit, talents, and virtue of the women in this circle.

As many scholars have noted, the typical bluestocking assembly was fairly conventional. The hostesses' emphasis on heterosocial conversation followed widely accepted views on gender and polite decorum for the stated ends of education, amusement, and the polishing of manners and taste. However, despite the traditional foundations, the bluestockings are also credited with building upon this conventional base through their collective efforts to theorize and enact new ways of engaging in public life. Bluestocking scholar Elizabeth Eger has argued that bluestocking women built upon the possibilities of polite spaces, not by radically altering the space but by emphasizing it as a place of female education, patronage, and moral authority. Evelyn Gordon Bodek has suggested that the space of the salon functioned as "an informal university for women—a place where they could exchange ideas" (185), and Eger points particularly to Elizabeth Montagu, "the Queen of the Blues," as a figure who reorganized the material spaces of polite venues to better enable female education and women's patronage of

artists and authors (61-62). Deborah Heller has also argued that the bluestockings encouraged more socially diverse audiences for their assemblies, bringing together a broad range of perspectives and opinions through varied audiences such as those described by Lady Louisa Stuart's account (64). In this manner, the bluestockings took advantage of the opportunities of polite spaces, not breaking with traditional decorum or the pieties of the space so much as stretching their boundaries or refocusing attention. To this scholarship, I add my examination of how the bluestockings rhetorically used spectacles of science to aid in this reimagining of the polite landscape.

It is important to recognize that the bluestockings had distinct opinions about how polite social encounter should occur. The women and men who contributed to the bluestocking circle possessed a spectrum of beliefs about politics, religion, education, and women's role in society. The bluestocking women further came from varied financial and social positions, ranging from Montagu who possessed an independent fortune derived from her late husband's investments in coal to women like Hannah More and Elizabeth Carter who earned part of their living from their published works. Perhaps it is not surprising, then, that these women did not always agree on the preferred forms of politeness or, when they did, the best way to facilitate polite interaction. An example of differing strategies for mediating polite engagements can be seen in the ways that hostesses Montagu and Vesey arranged the chairs for their assemblies. The differences in material arrangement impacted how guests could engage with each other and resulted in distinct styles of conversation. Montagu, for example, was known for arranging chairs in a huge circle with the highest ranking person and the most notable intellectual figure often seated at her side. In this manner, Montagu could personally regulate the subsequent single conversation. Using a different strategy, Vesey would arrange chairs in little groups, often with chairs facing back-to-

back to ensure that the difficulty of turning around would result in multiple conversations (Burney 276).<sup>34</sup>

With the same eye towards material and visual rhetorics, the bluestockings also relied on spectacular displays to facilitate certain forms of polite social behavior. Returning again to Montagu, the queen of the bluestockings was famous for including curious objects within her polite assemblies. The drawing rooms in her palatial home Montagu House, for example, were decorated lavishly in exotic materials and styles, such as the new fashion for Chinese objects, fabrics, and furniture (Eger 69). With such novel decorations, Montagu awed her visitors with surprising objects arranged in previously inexperienced ways. While the presence of exotic objects certainly demonstrated Montagu's refined tastes and displayed her enormous financial resources, Eger has argued that Montagu chose to see and argue for her lavish displays in *moral terms*, as exemplifying "Virtue, prudence, and Temperance" (Eger 74).<sup>35</sup> Rather than spending her fortune on personal and ephemeral pleasures, Montagu saw her consumption and display as a means of creating something of tangible value that facilitated education, taste, and manners through her entertaining. Because conversation and polite interaction were deemed principal means by which individuals could develop and display their virtues, resources spent enabling this activity and emphasizing its importance through grandeur and awe could be seen as a moral and virtuous enterprise.

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<sup>34</sup>Eger further explains that "[o]ne of the chief aims of bluestocking conversation was to orchestrate diversity into unity... Vesey's apparent artlessness was in fact a calculated attempt to define her assemblies against those of Montagu, who arranged her guests in large circles or semi-circles in order to promote unity of conversation. Vesey favoured a more random arrangement of small groups, thus hoping to erase the formal aspects of literary assemblies in favour of more relaxed company" (109).

<sup>35</sup>Eger argues that "it [is] important to understand that in some ways Montagu viewed the magnificent scale of her new house as an example of how to invest riches with moral weight. Describing a visit to Castle Howard in 1781, she wrote to Elizabeth Carter, 'a Man of great rank and fortune, who from his income constructs such a family seat is far preferable to him, who squanders that income in base and sensual pleasures and enjoyments.' In an age marked by an ostentatiously reckless aristocracy who gambled away fortunes on a regular basis, Montagu's cultural investment seemed virtuous, even abstemious" (73).



In addition to exotic cultural objects, Montagu similarly used science spectacles to enhance her polite displays and advance her preferred forms of polite interaction. Within her letters, we can find evidence that Montagu understood the sensational appeal of scientific curiosities like the magnified images produced by microscopes. In one letter, Montagu describes her frustration when the weather made her microscope unusable: “The sun will not shine for our microscope, which is a great vexation to the curious” (*The Letters of Mrs. Elizabeth Montagu* 90). Though Montagu was not able to entertain guests with the spectacular images of microscopic objects on this occasion, her letters show that she was adept at spectacular displays of natural objects. Perhaps her most famous exhibition of natural curiosity came from her feather-panel screen. Through her own collection, and with the assistance of many friends and acquaintances, Montagu gathered together the feathers of dozens of birds and blended the myriad feathers, of all different colors and sizes, into a dramatic multi-panel screen: “This feather screen was in six panels, one of which was worked by Miss Anstey, in imitation of one of the Duchess of Portland’s... Lydia Botham collected the plumage of peacocks, pheasants, and jays. Every known sort of parrot and macaw was placed under consideration” (*The Letters of Mrs. Elizabeth Montagu* 268). Describing the feather screens in his poem “On Mrs. Montagu’s Feather-Hangings,” poet William Cowper details how “the birds put off their every hue/ To dress a room for Montagu” (1-2):

The peacock sends his heavenly dyes,  
His *rainbows* and his *starry* eyes;  
The pheasant plumes, which round enfold  
His mantling neck with downy gold;  
The cock his arch’d tail’s azure show;  
And, river-blanch’d, the swan his snow. (3-8)

When taken together, the collection and dazzling display of multi-hued feathers offered an eye-catching and novel spectacle for audiences. A single feather might be beautiful or exotic,

however, the large arrangement brought together a rainbow of colors and textures, causing a “sensation” (Eger 73). The screen was so noteworthy that individuals even asked Montagu for admittance to her home when she was away in order to indulge their curiosity about her famed feather screen. In one letter, Montagu recounts such a request: “I received great civility from Mr. and Mrs. Vesey...They desired leave to see the house and celebrated feather screen, so I have wrote to Betty to have the house in order, and to set the screen for them” (*The Letters of Mrs. Elizabeth Montagu* 268).

More than a stunning display, the feather screen acts as a material argument for Montagu’s preferred vision for polite engagement. As previously mentioned, the bluestockings, Montagu included, believed that polite social encounters should accommodate diverse audiences and blend the company together through harmonious and beneficial conversation. As Eger argues, the artfully arranged feathers should be viewed as a “visual metaphor for her [Montagu’s] social ability to blend a variety of individuals into a bold display of harmony” (74). Accounts from the eighteenth-century such as those found in Cowper’s poem would suggest that Montagu’s contemporaries understood the message of the blended feathers. In his poem, Cowper maintains that “Genius, Learning, Fancy, Wit” can all exist in harmony within Montagu’s company:

There Genius, Learning, Fancy, Wit,  
Their ruffled plumage calm refit  
(For stormy troubles loudest roar  
Around their flight who highest soar),  
And in her eye, and by her aid,  
Shine safe without a fear to fade. (45-50)

Within the poem, Cowper connects the diversity of feathers on Montagu’s screen with the varied individuals who attended Montagu’s social events. Keeping with the comparison,

Cowper highlights Montagu's ability to maintain social harmony, despite her guests' variegated opinions and tastes. Cowper contends that the geniuses, intellectuals, fashionable mavens, and wits who attend Montagu's assemblies retain their polite composure, "their ruffled plumage calm refit." Though assemblies of great learning and fashion could become vain and boisterous displays, as "stormy troubles loudest roar/Around their flight who highest soar," under Montagu's watch, diverse individuals are able to "shine safe," both displaying their virtues and allowing other guests to do so as well.<sup>36</sup>

Although Montagu certainly played a critical role in mediating the conversation within her polite assemblies, the feather screen should not be taken solely as a paean to her abilities as host. The spectacle of the feather panel did more than draw attention to Montagu's abilities; it also served as a conversation piece and a request for congenial behavior from her guests, a material encouragement for those around her to also display and allow others to display their polite virtues. I argue that the screen further offers an example of how Montagu felt that spectacles should be deployed within polite settings: as a cause for reflection, a call to virtue, and an opportunity for continued conversation. In her letters, Montagu displays her belief that spectacles can mediate the social interactions of those in the audience. In one particularly distasteful example, Montagu describes how the excessive visual displays of Ranelagh Gardens—a London pleasure garden that catered to wealthy and aristocratic visitors—negatively impacted the ways that guests engaged with the space and with each other.

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<sup>36</sup>The notion that disparate objects can be brought together in a harmonious fashion can also be seen in other women's interior decorations. In her diary, Mary Hamilton shows how a bricolage of exotic and natural curiosities can be arranged into a harmonious design. Describing her cousin Lady Frances Hessel's dressing room, Hamilton comments: "found Lady Frances at home sat an hour with her in her dressing room which is a large room—well furnish'd in a comfortable manner with elegancies Books and China—Japan—Birds—Flowers—Cabinets—pretty tables... Trinkets—a great variety of things—yet all in order" (Tuesday, March 2, 1784). This provides evidence that other women also employed arrays of material objects, including scientific and natural curiosities, to establish a setting that visitors would read as harmonious.



Figure 6: Rotunda at Ranelagh Gardens by Thomas Bowles (1754)

In her letter, Montagu details how she went to Ranelagh the previous night and “walk’d around the Room so often that my brains were too hard twisted by it. The large Room is an Emblem of the World” (University of Nottingham Manuscripts and Special Collections PwE57). Despite the magnificence and variety exhibited at Ranelagh Gardens, Montague finds fault with the displays. She claims that the crowd was

great but so divided into sets and parties, there is little Society, the Variety of objects and the glaring lights confound discernment, most of the...good things were devour’d by the greedy, the rarities and elegancies were wasted by the idle; all the company express’d great weariness but linger’d as long as they could, declared a contempt for the place but betray’d a wonderfull [sic] anxiety about their particular seate. (PwE57)

Here the material arrangements and visual displays did not encourage the audience to converse with new partners and groups. Instead, Montagu suggests that parties remained in cliques and indulged in some of their baser tendencies. The “variety of objects and glaring lights” prompted a kind of manic consumption, quite at odds with Montagu’s sensational yet non-ruffling feather screen. At Ranelagh visitors devoured and wasted the intriguing sites, both expressing contempt

and weariness yet remaining anxiously present. This is contrasted with Montagu's style of spectacular display seen with the feather screen, which attempted to cultivate reflection and thoughtful conversation by using variety and novelty to foreground her message, rather than allowing variety and novelty to be the entirety of the message.

Indeed, Montagu seems invested in reducing the vanity that might be present in her own assemblies and displays. For example, in a letter to the Duchess of Portland, a childhood friend of Montagu's, the bluestocking ruminates on the potential for vanity and social disruption when observing scientific curiosities. In the letter, Montagu first invites Portland to an assembly, one that will showcase the display of an insect. In her own entertaining style, Montagu asks Portland: "If you think you shall be philosophically Disposed on thursday ye Wheel Insect will be glad of ye Honour of Ye Graces company, and promises to be in spirits as it by that time will have recover'd the fatigue of ye Drum it is to have on Tuesday" (PwE30). The invitation to the event, however, serves as a moment for Montagu to reflect on the collection of individuals that might be present. She begins by discussing the nature of the Virtuosi, scientifically minded gentleman often noted for their pedantry and lack of social graces: "The Virtuosi are a quiet kind of people and do not turn a meeting into a Rout or a Hurricane, but their Curiosity may be more troublesome than ye unthinking vivacity of the Gay" (PwE30). She continues, "[f]or they examine the motions of the heart, the Structure of the Head, and make nice Disquisitions into ye state of the Brain, whereas the Polite Visitant examines only the Brilliant Crop that glitters on the Bosom and observes no more of the Head than the Curling of the Hair and inquires no farther into the State of the Brain than to observe whether it has [sic] well directed in the choice of the top knott" (PwE30). After delineating the differences between the two categories, Montagu then proceeds to collapse the differences she has identified: "let us not blame either...every

employment of so short a Life is equally Vain and from the Spider in his Web to the Statesman in his Scheme all is Vanity,... whether we study the order of the universe and the motions of the Planets, or the Regular intricacies of a Country Dance; Metaphysical Disputes or Wirling [sic] Rebus's<sup>37</sup>; the Various natures of Insects, or Differing Dispositions of Mankind" (PwE30).

Montagu's lines—certainly a spectacular display of wit and learning in their own right—disrupt potential audience divisions by finding commonalities. By suggesting that all is vanity, given the brevity of a single life, Montagu establishes common ground between two seemingly dissimilar groups and even manages to critique the Virtuosi for a fault commonly attributed to the fashionable, namely vanity. Her letter to the Duchess of Portland suggests that Montagu was well aware of the potential tensions and divisions between those who might be interested in viewing an insect, albeit for different purposes. The insect display thus has the potential to bring together disparate groups, the Virtuosi and the Gay, perhaps even those with multiple or overlapping tastes, but only on the condition that Montagu could manage possible tensions amongst audiences members. Montagu ends her letter by claiming that one preoccupation—friendship—is, perhaps, worth serious attention: "If there be any thing (merely relating to this World) worth being Serious about I flatter myself it is that in which I am most Earnest in being the Duchess of Portland most Sincere and faithful friend" (PwE30). Although Montagu's final line is a polite salutation to her friend, it provides another piece of evidence for Montagu's views on the importance of polite social connection. Montagu might be known for her spectacular assemblies, which at times included spectacular displays of natural curiosities, but these were part of a larger enterprise that valued relationships and harmonious social interaction. When spectacles served to facilitate that goal, Montagu displayed them prominently and with much renown.

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<sup>37</sup>From the OED: "Rebus, n. A cryptic representation of a word or phrase by pictures, symbols, arrangement of letters, etc., which suggest the word or phrase, or the syllables of which it is made up; *spec.* an ornamental device, often of heraldic appearance, associated with a person to whose name it punningly alludes."

The emphasis on social harmony and thoughtful reflection within bluestocking assemblies becomes important when we take account of the reality of conversational practices. Although it was widely accepted that conversation could polish manners and bring together diverse individuals, this did not always transpire. Benjamin Stillingfleet, a frequent attendant of bluestocking gatherings, wrote an *Essay On Conversation* (1737) describing the inherent misanthropy of many conversationalists: “Yet, such our inconsistency of mind, We court society, and hate mankind” (4). Further explaining how actual conversation frequently veered away from the bluestocking ideal, Hester Chapone in her famous advice book *Letters on the Improvement of the Mind* (1773), originally written for her niece and published with the help of Montagu, explains how the virtuous benefit of conversation often comes from learning how to politely tolerate and interact with rude, boring, or ignorant companions:

our self-command may be improving by the exercise of politeness; which teaches us to offer our favourite opinions with modesty, to hear them controverted with good humour, and to maintain them with moderation: --to listen with patient attention to a tedious or a well-known story—to answer an objection that is nothing to the purpose, and make some civil reply to an argument too confused to be understood. These are useful, tho’ not very pleasant, exertions of benevolence and self-denial; and such utility may be derived even from those who can not otherwise contribute to our improvement. Many more pleasing advantages one should expect to find in the company of persons of fashion and education. (17)

Given the practical realities of eighteenth-century polite conversation, we can see how the rhetorical use of spectacles, dazzling visual displays, could be used as a means of vividly drawing attention to conventional—although perhaps not always performed—ideals and values.<sup>38</sup> These visual displays acted as a reminder and an argument—perhaps more successful

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<sup>38</sup> Another example of using science spectacles to direct attention to approved subjects and encourage appropriate behavior comes from Chapone’s *Letters on the Improvement of the Mind*. In this enormously popular advice book, directed at young women, Chapone talks about the necessity of study and including entertaining and amusing details within polite conversation: “Whatever tends to embellish your fancy, to enlighten your understanding, and furnish you with ideas to reflect upon when alone, or to converse upon in company, is certainly well worth your acquisition. The wretched expedient, to which ignorance so often drives our sex, of calling in slander to enliven the tedious insipidity of conversation, would alone be a strong reason for enriching your mind with innocent subjects of

than a verbal admonishment from women—to behave in certain ways and to hold themselves to the higher standard so many acknowledged verbally yet failed to implement through their actions.

Such vivid visual displays made bluestocking preferences present when such arguments were deemed contextually appropriate; however, a different take on spectacle was required when the arguments drew closer to contested boundaries of appropriate female behavior.

### *Displaying Absence*

This section turns attention away from women's display of curious objects and instead directs our attention towards women's display and performance of their scientific knowledge. As discussed in the previous section, bluestocking women like Elizabeth Montagu used curious and exotic objects to cultivate spectacular scenes and make visually stunning material arguments in polite social spaces. However, these women also expressed a concern that their displays of knowledge could become spectacles in a pejorative sense, as something deemed ridiculous, pedantic, or even monstrous. This section attends to the ways that bluestocking women theorized and enacted rhetorical strategies to manage the perception and interpretation of their knowledgeable displays. Whereas the previous section focused on bluestocking strategies for dramatically focusing presence through spectacle, this section examines how bluestockings

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entertainment, which may render you a fit companion for persons of sense and knowledge, from whom you may reap the most desirable improvements" (175-176). Here, Chapone sees the inclusion of "innocent subjects of entertainment" within conversation as a means of deflecting attention away from gossip or slander. Although she does not encourage young women to study "abstruse sciences," she lists Natural Philosophy, particularly the study of nature and astronomy, as appropriate and wondrous topics that could be used within conversation. Moreover, I'm intrigued by Chapone's insistence that conversation is an important means of study and that young women must read in order to appropriately contribute to conversation: "for, though I think reading indispensably necessary to the due cultivation of your mind, I prefer the conversation of such persons to every other method of instruction: but, this you cannot hope to enjoy, unless you qualify yourself to bear a part in such society, by, at least, a moderate share of reading"(176). In this manner, the display of entertaining scientific knowledge within polite conversation is part of a larger enterprise of education and instruction, one that women must contribute to in order to learn from.



enacted moments of cultivated absence to push against the boundaries of what was considered a vain display of female scientific knowledge.

Numerous scholars have spoken of the ways that eighteenth-century women became objects of the male gaze.<sup>39</sup> While this body of scholarship acknowledges the myriad ways women's objectification constricted their agency and autonomy, this scholarship also pushes back against the representation of women as passive objects for the viewing male subject. Feminist critic Juliette Merritt, for example, has argued that "women are never merely passive recipients of male looking; they do exercise power as subjects, although the exact nature and ultimate value of that power requires analysis" (18). Taking Eliza Haywood, a popular eighteenth-century author, as her primary case study, Merritt contends that Haywood sought to contest the power of the conventional spectral order—which placed men in the role of spectator and women in the role of spectacle—both by exploiting the "instabilities inherent in her role as spectacle" and by "abandoning the position [of spectacle] entirely to become a knowing spectator" (9). The following section adds to this scholarship—which seeks to understand how historical women exercised rhetorical agency despite constrictions imposed by patriarchal conventions—by examining how some bluestockings sought to control the perception and interpretation of their displays of scientific knowledge as spectacles.

As previously discussed, the women in and around the bluestocking circle exhibited an ambivalent attitude towards extensive displays of female education—praising women for their advanced learning while also expressing an anxiety that displays of this learning could be taken too far. We can see an example of this tension in Mary Hamilton's diary entry for July 10<sup>th</sup>, 1784, where she describes being both impressed and concerned over the social prospects for a

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<sup>39</sup>Scholars who analyze how women become the objects of a masculine gaze include John Berger, Laura Mulvey, Ann Kaplan, and Luce Irigaray.

young, highly educated girl she had just met. Hamilton describes meeting Miss Boyle and begins enumerating the surprising breadth of the girl's learning: "her [Mrs Boyle's] only daughter who is at yet age of 14 [is] ye most accomplish'd young Person I ever met with—She is mistress of music and Painting—Models in a surprising manner—knows perfectly Modern and Ancient history—French, Italian—Geography, Mathematics—Astronomy—ye English Classics—is learning Spanish and Latin etc." The sheer volume and combination of so many topics, combined with her relatively young age, positions Miss Boyle as a young female prodigy. And though Hamilton admires such intelligence and education, she questions in her diary whether this level of knowledge will ultimately hurt the young lady socially:

though I think Miss B: will reap many advantages from having received so very superior an education, I fear it will prevent her enjoying the innocent pleasure of society for every other female will not only envy but be afraid of her. And the Men in general are so jealous of our being as wise as themselves that they will shun her, None will associate with her but College Pedants, rigid Philosophers or pretended Femmes Savantes.  
(Saturday, July 10, 1784)

Predicting here that Miss Boyle will find it difficult to converse with both men and women—and that she will engender a combination of envy and fear from those around her—Hamilton contends that Miss Boyle has effectively narrowed her social circle and social standing by making her extensive education public.

Hamilton's diary entry is certainly sympathetic towards the young Miss Boyle but is markedly less so to the abstract figure of the female savante. Deriding such creatures, Hamilton claims that "an affected Femme Savante is in my opinion a most despicable animal—the reason of this is that they always pretend to more knowledge than they have, that they are ignorant of what they ought to know, are pert affected and useless members of society" (Saturday, July 10, 1784). As women, in general, were not socially authorized to inhabit the role of the highly educated and learned, and especially not to display such learning so prominently and proudly,

there is the underlying assumption that these women cannot actually possess their knowledge and that they are instead affected or pretended scholars. Yet despite such a vehement reaction to the figure of the female savante, Hamilton does acknowledge, in the very next lines, that she knows a few women—all from the bluestocking circle—who she would classify not as female savants but as actual learned women. Speaking particularly of Elizabeth Carter—the famous scholar, writer, and bluestocking—Hamilton gushes that “she is I imagine the most learned female that ever lived—hers is not a mere superficial knowledge and she is, most wise and good” (Saturday, July 10, 1784). She further suggests that “Miss More and Mrs. Chapone and two or three others I could name whom I likewise would except out of ye list of what I call Femmes Savantes for their talents and amiable precepts have been of great service to society” (Saturday, July 10, 1784).

So how did members of the bluestockings persuade audiences like Hamilton that they both possessed an expansive intellect without being classified as affected, ridiculous, or frightening? How did they manage to push against the boundaries of acceptable social behavior while still being of “great service to society”? In the remaining section, I address the rhetorical strategies used by bluestockings such as Elizabeth Montagu, Hannah More, and Hester Lynch Piozzi to influence the perception and interpretation of their knowledgeable displays.

In a few cases, eighteenth-century women can be seen to intentionally perform their scholarship and study in public settings, using their example to convince audiences of the viability and suitability of female scholarship. Perhaps not surprisingly, Elizabeth Montagu, the bluestocking who made such dramatic use of curious scientific objects to make arguments about politeness, also, on occasion, used her own body to perform the possibility of female scholarship. Montagu describes how she purposefully demonstrates her scholarship in front of polite

audiences: ‘If I sit with my Shakespeare and my Brumoy in Publick, I may appear in the light of Miss Biddy Tipkin to any visitors not so used to see ye pen as ye needle in the hands of a Woman. But why should I ever despise our friends not to be in the study when I am there?’ (Montagu, Letter to Sarah Robinson). Eger explains that “Miss Biddy Tipkin was the heroine of [Richard] Steele’s play, *The Tender Husband* (1705), whose excessive reading guides all her actions and perceptions. Biddy’s performance of private readings in public areas made visible contemporary anxieties about the effects of reading on women” (108). Notably, Montagu is performing her scholarship silently, drawing attention to the act of her reading and writing while not, at this moment, displaying the fruits of her scholarship through spoken words.

Hannah More, one of the more socially conservative members of the bluestocking circle, also chose to deliberately omit certain words during her own displays of knowledge and in her rhetorical theorizing about the use of scientific knowledge in conversation. From her enormously popular advice book *Strictures on the Modern System of Female Education* (1799), More specifically singles out as problematic women who drop scientific terms into conversation: “Society, too, is a sort of magic lantern; the scene is perpetually shifting. In this incessant change, the evanescent fashion of the present minute, which, while in many it leads to the cultivation of real knowledge, has also sometimes led even the gay and idle to the affectation of mixing a sprinkling of science with the mass of dissipation.” (54). Describing the current vogue for scientific ideas and conversation as occasionally a genuine prompt for learning, she nevertheless expresses a concern about those who would affect knowledge that they do not possess. Similar to the charge leveled at female savantes by Mary Hamilton, More sees and chastises those women who would draw attention to themselves with the “sprinkling of science” as “triflers” who “set off the reality of ignorance with the affectation of skill” (53). Such people

make themselves look ridiculous to the more knowledgeable and display vanity more than intelligence.<sup>40</sup> Instead of such pretensions, More makes the following suggestion:

But instead of producing in conversation a few reigning scientific terms, with a familiarity and readiness, which ‘Amaze the unlearn’d, and make the learned smile,’ would it not be more modest even for those who are better informed, to avoid the common use of technical terms whenever the idea can be as well conveyed without them? For it argues no real ability to know the *names* of tools; the ability lies in knowing their *use*. And while it is in the thing, and not in the term, that real knowledge consists, the charge of pedantry is attached to the use of the term, which would not attach to the knowledge of the science.” (55-56)<sup>41</sup>

Here, More presents her rhetorical theories about how women should incorporate scientific information in polite conversation. She has been emphatic in her support for women’s education, encouraging even the vain triflers to attend a course of lectures and supplement their learning by reading, and it would seem that her rhetorical recommendations would save this group from the display of their ignorance. However, in the last lines of the passage, More chooses to also include those who are “better informed” in her address, suggesting that her rhetorical recommendations could also benefit those who have had the time, resources, and inclination to educate themselves and who face, because of their greater knowledge, “the charge of pedantry.” Importantly, her suggestion to omit the “technical terms” of science addresses both problems of the gendered display of scientific knowledge—preventing the affected from “sprinkling” in scientific jargon and providing a strategy for “better informed” women to influence how their display of knowledge is perceived.

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<sup>40</sup>More continues: “The ambition of appearing to be well-informed breaks out even in those triflers who will not spare time from their pleasurable pursuits sufficient for acquiring that knowledge, of which, however, the reputation is so desirable. A little smattering of philosophy often dignifies the pursuits of the day without rescuing them from the vanities of the night. A course of lectures (that admirable assistant for enlightening the understanding) is not seldom resorted to as a means to substitute the appearance of knowledge for the fatigue of application; but where this valuable help is attended merely like any other public exhibition, and is not furthered by correspondent reading at home, it often serves to set off the reality of ignorance with the affectation of skill” (53).

<sup>41</sup>Critically, this passage should not be read as encouraging women to hide their understanding, for early in the chapter More claims that “[w]omen too little live or converse up to their understanding; and however we have deprecated affection or pedantry, let it be remembered, that both in reading and conversing the understanding gains more by stretching, than stooping” (53).

There is something very intriguing in More's suggestion that "the charge of pedantry is attached to the use of the term, which would not attach to the knowledge of science." Certainly, as one of the more socially conservative members of the bluestocking circle, More was invested in reiterated performances of conventional female virtues like modesty, silence, and religious devotion. However, More's last comment suggests that there are additional stakes in encouraging women to refrain from using technical scientific terms. In addition to performing conventional female virtues, in this case displaying "more modest" behavior, the deliberate absence of scientific terms, according to More, would release women conversationalists from the charge of pedantry *even as* they continued to display their scientific knowledge in conversation. I think it is important to acknowledge that More is not suggesting that women be silent—to study in public lectures or their homes and to keep such information out of polite conversation. Instead, she is advocating for a display of scientific knowledge that goes beyond the affected or superficial level yet does not include the technical terms that women are not authorized—within a conservative worldview—to use. Employing such terms tends to result in charges that a woman has a pretended knowledge—she does not really understand what she is saying—or that she has pushed too far against the acceptable boundaries of female education, becoming a pedant who causes envy and fear in those around her.

However, More's passage suggests a way to rhetorically side step this contentious issue. Although the words remain problematic, outside of women's acceptable uses of polite discourse, women can still display knowledge and show a high level of comprehension through the vivid use of verbal scientific imagery, effectively proving that one understands the *uses* of science without invoking the names of its technical *tools*. In this manner, More suggests that women could negotiate the conventional boundaries to polite behavior and utilize the opportunities

available in vivid verbal display even as they adhered to gendered restrictions against technical or “pedantic” language.

We can see this rhetorical strategy at work in More’s published texts, particularly her poem “Bas Bleu” (1786) where she describes the bluestocking gatherings and makes an argument about how others should perceive and interpret the group’s conversation. In this poem she liberally incorporates vivid verbal imagery of scientific topics while omitting most of the technical jargon she advises against. More repeatedly calls on scientific metaphors to praise the bluestocking style of conversation—which invites a diverse and harmonious group of people to share amusing and instructive conversation. Using the metaphor of electricity, More claims that “No dry discussion to unfold/ The meaning, caught as soon as told:/ But sparks electric only strike/ On souls electrical alike” (284-87). Continuing to use scientific metaphors to praise the particular conversational style of the bluestockings, More uses ideas from geometry to explain Mrs. Vesey’s habit of arranging chairs haphazardly around her parlor to encourage numerous small conversations:

See VESEY’S plastic genius make  
A Circle every figure take;  
Nay, shapes and forms which wou’d defy  
All science of Geometry,  
Isosceles, and Parallel,  
Names hard to speak, and hard to spell!  
Th’ enchantress wav’d her wand, and spoke!  
Her potent wand the Circle broke;  
The social Spirits hover round,  
And bless the liberated ground.  
Ask you what charms this gift dispense?  
‘Tis the strong spell of COMMON SENSE. (140-151)

Perhaps More ventures too close to the technical using terms like “Isosceles” and “Parallel” in reference to geometric patterns of Mrs. Vesey’s parlor chairs, but she acknowledges the limit she is approaching by suggesting that these terms might be “hard to speak, and hard to spell!” She

then retreats from the potential charge of pedantry by arguing that the bluestocking style of conversation favors “COMMON SENSE.” More continues to sprinkle scientific metaphors into her poem, later using the chemical concept of amalgamation to convey how harmoniously the diverse group of bluestocking conversationalists interact: “But Chymists too, who want the essence,/ Which makes or mars all coalescence,/ Of her the secret rare might get,/ How different kinds amalgamate” (156-59). Importantly, More is not just dropping in terms like “Chymist,” “Isosceles” or “electrical” into her poem, she is demonstrating her fair grasp of the underlying science by shaping these concepts into metaphors praising the conversational bluestocking style. Here again, we see the use of restrained spectacle with More employing scientific concepts without too much jargon in order to argue for her preferred forms of polite social interaction, such as encouraging “different kinds [to] amalgamate.”

Another example of a bluestocking woman who incorporated scientific ideas into her conversation while eschewing the more pedantic scientific terminology comes from Hester Lynch Piozzi, formerly Hester Thrale. Piozzi was something of a child prodigy herself and encouraged her daughter Queeney in some of her more precocious displays of intellect. In Piozzi’s writing, we can see a similar tension—found in More, Hamilton, and Montagu’s works—between displaying knowledge and engaging in pedantic discussions of esoteric topics. In *British Synonymy; or, An Attempt at Regulating the Choice of Words in Familiar Conversation* (1794), Piozzi’s responds to her close friend Dr. Samuel Johnson’s newly published dictionary and suggests her text as an aid to non-native English speakers who wish to know how to converse in polite situations or “familiar conversation.” Piozzi models her text on the dictionary genre, including word entries—often a series of words—and explanations of both the word/s and its/their applicable use in familiar conversation. In her entry for “Principle,



Element, Rudiment, Primordial Substance,” Piozzi explains, “[o]f these words in common conversation we make little use, but ‘tis because conversation seldom discusses the truths of natural philosophy, or traces the maze of metaphysical disquisitions, else we should find occasion for them all” (162). As previously established by Hamilton, More, and Montagu, scientific topics were often sprinkled into conversation, so natural philosophy was discussed in a general manner during polite conversations; however, as Piozzi points out, delving into detailed or pedantic aspects of scientific theory, such as tracing the “maze of metaphysical disquisitions,” was not generally approved. Yet it is clear, in her denial of what not to discuss that Piozzi is well versed in the scientific theories of the day. Although these terms might not be appropriate in conversation, Piozzi makes clear that she is familiar with the words and their definitions: “We justly call the soul our thinking PRICIPLE; none of the other words would do in this place: fire, water, earth, and air, are ELEMENTS, while salt, sulphur [sic], and spirit are denominated in chymistry the three active PRINCIPLES” (162-63). The issue in this section seems to be the appropriateness of such words and theories in familiar conversation, not whether women like Piozzi were capable students of such subjects. Even as Piozzi calls for their absence in polite conversation, she clearly displays her facility with the scientific ideas.

In another rhetorical move similar to More’s, we also see Piozzi use vivid displays of scientific information as analogies and arguments for her preferred notions of social interaction and social hierarchy. In an entry on “Order, Method, Regulation, Arrangement,” Piozzi explains the relationship between this string of words, particularly emphasizing the importance of social order and hierarchy through an appeal to scientific imagery. Piozzi describes how inherent arrangements—like social order—might be shaken up by agitations, but they will return back to

their original states when calm. Using a scientific comparison to make her point, Piozzi argues that

because agitation cannot alter the nature of fluids or their specific gravity—when agitation has ceased...the true level of each will be found... ‘tis well known that one ounce of camphor will be so dissolved and apparently so annihilated, that neither scent, nor taste, nor alteration of transparency can be found in this phial, if grated into an ounce of alcohol; ‘tis likewise known, that the addition of some fair clean water the camphor shall again be disengaged from the spirit, and rise to the surface once more, white, solid, perfect, without diminution of its weight, smell, or medical efficacy from the experiment. (86-87)

Here, Piozzi uses a discussion of chemical agitation to comment on recent debates about whether social “equalization” was possible or even desirable. In this passage, Piozzi clearly comes down on the side of a social order in which there is social hierarchy, claiming that “loss of ORDER in the ARRANGEMENTS of civil society would produce, nay does produce the most fatal of consequences”(86). Although Piozzi’s use of a scientific analogy to naturalize social hierarchies is certainly problematic, this serves as another example of how bluestocking women utilized new theories of science and the spectacle of their scientific knowledge to make arguments about their preferred forms of social and polite interaction.

Importantly, the bluestocking women discussed in this section—Montagu, More, and Piozzi—engaged their scientific knowledge to mediate polite social interaction, both in advising others in how they should behave in polite social spaces and in arguing for how their audiences should interpret and perceive their behavior. At times, this mediation allowed them to push back against the boundaries of what was considered appropriate behavior. Such displays attempted to manage the constraints faced by eighteenth-century women—which, it must be acknowledged, were frequently reconstituted by the advice, arguments, and actions of bluestocking women. These displays of knowledge utilized a cultivated absence, which sidestepped some of the more contentious verbal boundaries placed on women’s display of knowledge and instead relied on

vivid verbal imagery to evidence their knowledge of scientific matters. Concerned about appearing as ridiculous and affected scholars or frightful pedants, the bluestockings theorized how to use science spectacles for their own rhetorical ends.

## Conclusion

In her edited collection *The Correspondence of Samuel Richardson...to which are prefixed a biographical account of that author, and observations on his writing* (1804), Anna Laetitia Barbauld addresses Richardson's opinions about women's education and briefly touches upon broader mid-to-late eighteenth-century views. Reflecting on the shifts in public opinion about women's displays of "mental improvement," Barbauld comments:

The prejudice against any appearance of extraordinary cultivation in women, was, at that period, very strong. It will scarcely be believed, by this generation, that Mrs. Delany, the accomplished Mrs. Delany, objects to the words intellect and ethics, in one of the conversation pieces...as too scholastic to proceed from the mouth of a female. What could some of these critics have said, could they have heard young ladies talking of gases, and nitrous oxyd, and stimuli, and excitability and all the terms of modern science. (clxiii-clxiv)<sup>42</sup>

Here, Barbauld speaks of Mrs. Delany, a remarkable bluestocking figure who created scientifically accurate representations of plants and flowers, which are currently displayed in a rotating selection in the "Enlightenment Room" of the British Museum. Much like More, Delany here is described as a bluestocking woman who negotiated the mid-to-late eighteenth-century dictums against women's excessive displays of knowledge—cautioning against the "appearance of extraordinary cultivation in women" even as she established a lingering reputation for her own extensive accomplishments. Numerous bluestocking-circle women—More, Delany, Montague, Piozzi—provide evidence that negotiations of such constraints were possible and also show how natural curiosities and scientific ideas—amongst other ephemera of the Enlightenment age—

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<sup>42</sup>Also in this text, Barbauld mentions shifts in eighteenth-century opinions about women's education and displays of knowledge. According to Barbauld, the earlier part of the eighteenth century actually exhibited more liberal attitudes towards women's learning, while the latter decades became increasingly conservative.

became useful rhetorical resources for advancing their arguments in socially acceptable and contextually appropriate ways.

Engaging in their socially sanctioned role as mediators of polite interaction and conversation, eighteenth-century women like the bluestockings employed natural phenomena and scientific spectacles to enhance and negotiate their own displays of politeness, to argue for preferred visions of polite engagement, and to encourage others to engage in similar beneficial display. Such women also utilized the expanded rhetorical opportunities enabled in polite spaces and the mixture of verbal and visual forms to push against the boundaries of acceptable gendered behavior, specifically the boundaries of what constituted a spectacular display of women's knowledge.

Despite their attempts to negate charges of affectation or pedantry, the bluestockings were not able to forestall some of these charges. Particularly in the late eighteenth-century, decades after the height of the bluestocking assemblies, the bluestocking women became increasingly ridiculed for their intellectual ambitions. In the following chapter, I examine women's attendance at public science lectures during the late eighteenth century. In addition to performing their scientific knowledge during polite conversation, eighteenth-century women also attended, in large numbers, public science lectures and shows. I investigate how women's enthusiastic attendance shaped the meanings associated with spectacular public science displays and how male audiences members struggled to make sense of how the spectacle of women's interest impacted conceptions of science.

## FASHIONABLE SCIENCE AND WOMEN SPECTATORS AT THE ROYAL INSTITUTION

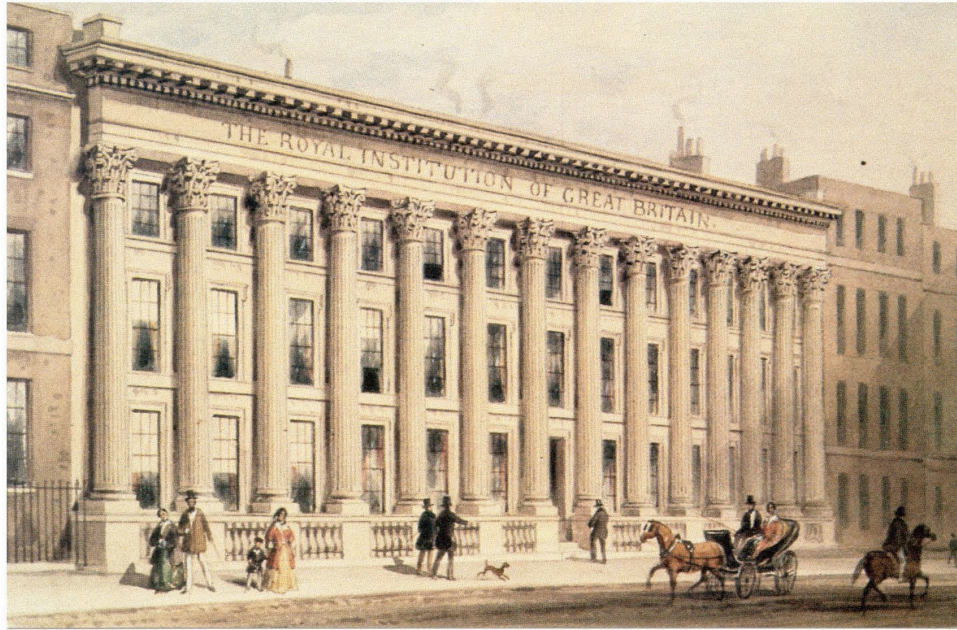


Figure 7: The Royal Institution of Great Britain painted by Thomas Hosmer Shepard (circa 1838)

In March 1800, a brief notice appeared in *The Gentleman's Magazine* to announce the first sitting of The Royal Institution:

A Society under the title of 'The Royal Institution of Great Britain,' and under the patronage of his Majesty, commenced its sittings, for the first time, this day. Its professed object is to direct the public attention to the arts, by an establishment for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements. (Nicholas 382)

More practical and inclusive than other scientific societies, such as the older and more prestigious Royal Society, The Royal Institution was originally envisioned as a “clearing-house”

for scientific information and technical know-how (Foote 6).<sup>43</sup> The founders imagined a physical space at Albemarle Street in London where professors could instruct working-class men in mechanical principles, lecture to aristocratic and middle-class audiences, exhibit mechanical innovations and models, all while experimenting and contributing to the stores of scientific knowledge. Emphasizing the institution's focus on the practical applications of science, one of the founders Benjamin Thompson, Count Rumford, described his ambitions for the institution: "I am only desirous that *science* and *art* should once be brought cordially to embrace each other, and to direct their united efforts to the improvement of agriculture, manufacturers, and commerce, and to the increase of domestic comfort" (10).

As mentioned in the opening notice, the Royal Institution was dedicated to sharing scientific and applied knowledge with public audiences for the advancement of the common good. One of the early professors at the Royal Institution, Dr. Thomas Young, argued that the institution performed "what the idolized sophists of antiquity but verbally professed, to bring down philosophy from the heavens, and to make her an inhabitant of earth" (Young 3-4). This line echoed previous calls for a diffusion of knowledge, such as those by Joseph Addison, a magazine publisher and author, who in the early eighteenth century famously stated that he wished to bring "Philosophy out of Closets and Libraries, Schools and Colleges, to dwell in Clubs and Assemblies, at Tea-Tables, and in Coffee-Houses" (53). The Royal Institution thus participated in a larger philanthropic movement, which began during the eighteenth century and sought to promote cultural improvement and civic good in Great Britain through the diffusion of specialist knowledge (Guenther).

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<sup>43</sup>Natural philosophy professor Dr. Thomas Young described the Royal Institution as "more practical than academies of science and more theoretical than societies for the improvement of arts" (1: 3).

However, as this chapter will address, the Royal Institution's project of public science education and applied works was more contentious than the founders anticipated. Despite the resounding success of the Royal Institution with patrons and public audiences alike, there were fierce disagreements about how the Royal Institution should advance public knowledge of scientific theories and mechanical innovations. Early plans for a mechanics' school, a journal, workshops, and kitchens were abandoned, and the Royal Institution eventually became known for two activities: its enormously popular public lectures and the scientific research performed by its professors. In this chapter, I argue that the early formation of the Royal Institution, from 1799-1810, showcases the competing, and increasingly agonistic, views of public science, or public participation in science outside of legitimate scientific experimentation, in the late eighteenth and early nineteenth centuries. Examining the early plans for the Royal Institution, as well as what eventually succeeded, illuminates how class tensions, gender anxieties, and concerns over scientific rigor shaped the possibilities for public science participation at the turn of the nineteenth century in Great Britain.

Before continuing, it is important to briefly note the scientific accomplishments of the Royal Institution professors, who both lectured to public audiences and experimented in Royal Institution laboratories. Humphry Davy and Michael Faraday, in particular, were two professors acknowledged for their scientific research during their lifetimes and much of their contributions to the fields of physics and chemistry still stand. Davy, in addition to giving hugely popular lectures on chemistry, galvanism, and nitrous oxide, conducted experiments on electrolytic decomposition and identified chlorine as an element (Golinski "Humphry Davy" 22). These scientific accomplishments qualified him for prestigious appointments at the Royal Society, becoming secretary and then president, after he left the Royal Institution. Michael Faraday, one

of Davy's successors at the Royal Institution, became even more famous as the discoverer of benzene and for his groundbreaking experiments on electro-magnetic induction.<sup>44</sup> The law of electro-magnetic induction still bears Faraday's name. Other professors, though never reaching the heights of Davy and Faraday's fame, were still considered to be top scientific minds of the period, performing scientific experiments and presenting their research to the Royal Society. I touch upon the collective accomplishments of the professors to foreground the tensions created by the Royal Institution's public science projects. For even with the recognized expertise of the professors, and with the acknowledged value of their experimental work, the immense success of the public lectures soon earned the institution a reputation for dilettantism.

The institution's reputation for fashionable amateurism can be seen in published works from the period. In his account of the "rise, progress, and present condition" (v) of the scientific societies and institutions in Great Britain, author Bernard Becker describes the Royal Institution as "that stronghold of fashionable science" (27). In another representation, Thomas Carlyle evoked the romantic sentiments of the era by arguing that the Royal Institution functioned as "a kind of sublime *Mechanics' Institute* for the upper classes" (1: 62). Specifically addressing the disjunction created by housing scientific experimentation and public instruction in the same space, an Edinburgh reviewer expressed his surprise that, after a decade of teaching, Humphry Davy's reputation as a scientist was not more damaged by his association with the institution: "it is no small proof of Mr. Davy's natural talents and strength of mind, that they have escaped

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<sup>44</sup>Comparing the scientific accomplishments of the two prominent professors, Royal Institution historian Bence Jones claims that "[w]henver a true comparison between these two nobles of the Institution can be made, it will probably be seen that the genius of Davy has been hid by the perfection of Faraday. Incomparably superior as Faraday was in unselfishness, exactness, and perseverance, and in many other respects also, yet certainly in originality and in eloquence he was inferior to Davy, and in love of research he was by no means his superior. Davy, from his earliest energy to his latest feebleness, loved research; and, notwithstanding his marriage, his temper, and his early death, he first gained for the Royal Institution that great reputation for original discovery which has been and is the foundation of its success" (viii).



unimpaired from the enervating influence of the Royal Institution; and indeed grown prodigiously in that thick medium of fashionable philosophy” (Francis “ART. VIII” 390).

The Royal Institution’s fashionable reputation was undoubtedly linked to the well-attended public science lectures given to aristocratic and middle-class audiences. An account from the first earl of Minto showcases how audience members were often as aware of each other as they were of the events occurring on stage: “It is curious to see ex-Ministers and a number of our politicians attending these amusements... Lord Spencer is a constant student; [and] there are a great number of women, principally matrons with young daughters, who take notes and carry their syllabus as boys do in Edinburgh” (3: 240). As demonstrated in Minto’s description, the Royal Institution’s plan to distribute scientific knowledge was well-received by upper- and middle- class audiences. Ex-ministers, lords and ladies, as well as members of the burgeoning middle class enthusiastically attended the lectures, which offered spectacular displays of chemical and mechanical science.

The fashionable associations of the audiences, however, complicated perceptions of the rigor of the scientific lectures. Historian George Foote has argued that despite the valuable cultural and financial patronage that fashionable audiences provided, their support undermined the educational credibility of the institution:

the support of [the] Institution by the wealthy and fashionable set of London made possible to a large extent the maintenance of the Albemarle Street establishment. Their interest in attending the lectures, whether or not they understood them, attested an interest in science and technology. True, they gasped and applauded the chemical experiments which took their fancy, without understanding these same experiments [although it is an injustice to many an unknown member of the early audiences to say this]” (11-12, bracket in the original).

Foote further speculated that the sense of “pressure for lessening standards must have been very great on Davy” (10). This concern over the lessening of rigor, and whether audiences understood

the topics discussed, was compounded by the gendering of the audience. Though fashionable and aristocratic audiences were already perceived as somewhat feminized, this was exacerbated by the large number of women, girls, and fashionable male dandies in the audience. As the earl of Minto commented, matrons and their daughters were seen taking notes, a common observation as the audience was frequently half female.

This chapter examines the multiple, often competing visions for public science that emerged amidst the formation of the Royal Institution. Most contributors and visitors to the Royal Institution agreed on the vague philanthropic project of “diffusing the knowledge and facilitating the general and speedy introduction of new and useful mechanical inventions” (Rumford 17), but this theoretical prospect became much more problematic in practice. In the years immediately after the French Revolution, the philanthropic ideals instantiated in the early eighteenth century clashed with British fears that revolutionary politics might invade England as well. As British society became more politically and culturally conservative, the Royal Institution’s plans to distribute scientific knowledge to all ranks of society became much more contentious. Lectures in which “the nobleman, his gardener and the newly-rich manufacturer” (Cantor 94) could sit and learn together became increasingly suspect. Moreover, the gradual gendering of the Royal Institution audience—through the large numbers of women present, the fashionable associations of the primarily upper-class or bourgeois audiences, as well as the visible enthusiasm of the crowd—negatively colored other audiences’ perceptions of the Royal Institution’s educational goals as well as the experimental accomplishments of the professors. In this chapter, I explore how the leadership of the Royal Institution, the professors, and the audience members collectively negotiated the priorities and boundaries of public science at the Royal Institution.

I particularly focus on the persistent characterization of the Royal Institution as a place of “fashionable science.” Of course, the term “fashionable” had variable meanings at the turn of the nineteenth century, ranging from an indication of wealth and social status to the characterization of an activity or person as superficial, frivolous, unintellectual, and dissipated. Perhaps reinforcing its fashionable associations, the Royal Institution was deemed fashionable based on multiple understandings of the term. Not only did the leadership of the Royal Institution cultivate wealthy and fashionable audiences (for the admittedly expensive task of maintaining the Albemarle Street location), but the enthusiastic responses of those audiences incurred further critiques that the institution was devolving into a place of frivolous scientific entertainment.

Undoubtedly, the characterization of the Royal Institution as fashionable brushed up against contemporaneous debates about scientific professionalization, or who could legitimately participate in scientific activities. However, I argue that the characterization of the Royal Institution as fashionable is more fruitful if we view it as part of a larger negotiation about the future of *public science*—or how public audiences might variously use science for non-scientific ends. Certainly, there were some scientific professionals in the audience of the Royal Institution lectures, such as physicians, who came to hear about the latest research of the professors; but most audiences were comprised of non-experts who were not seeking admittance into laboratories or learned societies. Instead, the concerns about whether the Royal Institution had become too fashionable emerged amidst questions of what non-experts could legitimately do with science in their everyday lives: Should non-experts use scientific knowledge for non-scientific, perhaps even fashionable, ends like conversation or courtship? Could scientific neophytes find ways to use technical know-how to benefit themselves and their communities? Did the visible participation of novices inevitably denigrate more professional versions of

science? Ultimately, the formation of the Royal Institution offered a site for multiple communities to debate about how open and expansive public science and public science education projects should be.

In what follows, I contend that characterizations of the Royal Institution as fashionable—catering primarily to wealthy, feminine, and dilettantish audiences—worked to obscure the possibility of multiple, heterogeneous public uses of science. Instead such calls narrowed visions of public science, positioning it primarily as superficial scientific entertainment that was increasingly distinct from the serious work of scientific study and experimentation.

### **Creating a Public Institution: The Leadership of the Royal Institution**

In 1799 Count Rumford, acknowledged as the man behind the idea for the Royal Institution, distributed his initial proposal for the philanthropic project. Expansive in its conception, the early proposal called for “forming in this capital, by private subscription, a Public Institution for diffusing the knowledge and facilitating the general and speedy introduction of new and useful mechanical inventions and improvements; and also for teaching, by regular courses of philosophical lectures and experiments, the application of the new discoveries in science to the improvement of arts and manufactures” (17). This early proposal exhibited a confident attitude that, if followed, Rumford’s plan could “excite a spirit of inquiry and of improvement amongst all ranks of society,” “afford the most effectual assistance to those who are engaged in the various pursuits of useful industry,” and “promote the public prosperity” (Rumford 17-18). These grand ambitions resonated with other well-connected and scientifically minded men of the period, and Rumford’s proposal was initiated with the assistance of 58 original contributors, who each offered 50 guineas (roughly 50 pounds) to found the institution

(Rumford 21).<sup>45</sup> With this initial backing, Rumford purchased a house in London, on Albemarle Street, and began extensive renovations to construct a lecture theatre, workshops, exhibition halls, and kitchens. Because of the immense scope of the project, Rumford needed not only financial assistance but also help running the institution, and the first set of managers—including Rumford—was selected from amongst the original contributors (Rumford 21). Thus, from the beginning, the Royal Institution was a collective enterprise—conceived in Rumford’s proposal but instantiated through the financial and managerial assistance of men who would often disagree with Rumford’s interpretation of “public prosperity.” In this section, I show how the leadership of the Royal Institution, initially pulled from the founding contributors, variably interpreted the public goals of the Royal Institution and fought for their preferred vision of public science.

Rumford’s vision for the institution was an expansive one, seeking to cultivate a space of public education and exhibition that could benefit “all ranks of society.” Proposing a number of projects housed within the Royal Institution, Rumford suggested—and began the costly construction of—a lecture theatre, workshops for building model replicas of mechanical contrivances, as well as exhibition spaces that displayed full-size models of new mechanical innovations such as fireplaces, kitchens, and ventilators. These renovations, it was imagined, would provide various benefits for individuals across the social strata of London. Wealthy upper- and middle-class audiences would benefit from public lectures and the exhibition of mechanical innovations (and subsequently help finance the institution through continued subscriptions). Working-class individuals would benefit from the application of scientific knowledge and technological innovation to common problems, such as the preservation of food, and through

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<sup>45</sup>Of the 58 proprietors who originally contributed, “29 were titled, 18 were Members of Parliament and 18 were Fellows of the Royal Society” (Cantor 108).

direct education in a proposed mechanics' school. Rumford was serious about the potential benefits for the working poor in London, and for this reason he solicited support from members of the Society for the Bettering the Condition of the Poor, several of whom became founding members and later managers of the institution (Jones 140-141). In Rumford's scheme, it was understood that the wealthy and philanthropic would be financial backers and should benefit from new scientific and technological advancements, but that the working classes would be the primary benefactors of new scientific applications that could improve their standard of living. Royal Institution historian Bence Jones has argued that, under Rumford, the Royal Institution's "primary objects were models, workshops, and useful knowledge to benefit the poor; lectures, researches, and scientific experiments to amuse and interest the rich and to advance science were comparatively the secondary intentions of its founder" (147).

Rumford's expansive vision of public science was also quite expensive, and the spiraling costs of the Royal Institution's numerous projects opened space for other managers to express alternative visions for the institution. In particular, a number of Royal Institution managers and members objected to Rumford's plans to educate working-class men in a mechanics' school. In the wake of the French Revolution and on the eve of the Napoleonic Wars, the more conservative members demanded that this aspect of the Royal Institution's public science program be dropped. The contention over the project can be seen in a letter written by Mr. Webster, the architect for the Albemarle Street construction project, who was an advocate for the proposed school:

I was asked rudely (by an individual whom I shall not now name) what I meant by instructing the *lower classes* in science. I was told likewise that it was resolved upon that the plan must be *dropped as quietly as possible*. It was thought to have a dangerous political tendency, and I was told that if I persisted I would become a *marked man*! It was in vain to argue—the time was unfavourable—and I found the necessity of yielding. No notice was ever given publicly that the idea of instructing the mechanic was abandoned,

and I have no doubt but that in many parts of the kingdom the Institution got the credit of great liberality long after the mechanics' school had become extinct. (qtd. in Jones 194)

Arguments over the perceived costs of Rumford's various projects provided further reasons for abandoning aspects of his agenda. Meetings were held to determine cost-saving measures, and when Rumford left the Royal Institution in 1802 "those objects which he had considered likely to bear the best fruits at the Institution were marked for destruction, and they gradually withered away" (Jones 200). Jones contends that

[t]he state of the funds was the cause of the immediate change. The bills due were 3,900l., the balance at the bankers' was 3,180l. The arrears came to 4,960l.10s, but these were chiefly bad debts. In 1799 the income was 6, 379l.; in 1800, 11, 047l.; in 1801, 3, 474l.; whilst in 1802 it was only 2,999l. Moreover the expenditure was increasing. Meeting after meeting was held in May 1802 to make arrangements for reducing the expenditure in the workshops and printing-office." (200-201)

The projects that were abandoned and those that were chosen for continued investment after 1802 demonstrate a markedly different vision for public science than the one offered by the Royal Institution's originator.

The managers that came after Rumford offered a much revised, and more fashionable, in the sense of wealth and status, vision of public science. Instead of embracing Rumford's expansive program, the new managers Thomas Bernard and Sir John Hippesley chose to devote funds and attention to a narrower range of projects that were intended to appeal to wealthier audiences. Under their leadership, the Royal Institution quit its emphasis on working-class education, the exhibition of mechanical inventions, the workshop production of models and instead shifted attention to popular lectures on science, literature, moral philosophy, and art as well as scientific experimentation. Comparing the differences in the Royal Institution before and after 1802, Royal Institution historian Jones argues: "It is clear that Count Rumford and Sir Joseph Banks especially desired the promotion of scientific knowledge among the poor and rich,

and that Mr. Bernard and Sir John Hippesley believed that the success of the Institution depended upon fashionable popularity” (261). Bernard and Hippesley, it was suggested “knew nothing of science but much of the world” (Jones 258), and thus directed the institution towards projects that would appeal to more worldly audiences. In Bernard’s 1803 account of the “state and progress of the Institution,” he describes the new state of the Royal Institution:

The fabric of the Royal Institution is now completed by the efforts of individuals... The attempt has been as arduous as the object has been great and important—not less than that of giving fashion to science and of forming a centre of philosophical and literary attraction, for supplying instruction to the young, and rational amusement to mature life, with essential advantages to the public and increase of resources to the country by new discoveries and improvements in the arts and manufactures. (qtd. in Jones 205)

Importantly, Bernard’s account of the revised direction for the Royal Institution suggests that he and the other managers still considered the institution to be providing “essential advantages to the public.” However, the managers’ conception of the public and public science has shifted in considerable ways. There continued to be an emphasis on distributing scientific knowledge to wide audiences—reaching both the young and mature, for example—yet this diversity has been collapsed within the upper and middle classes. Scientific information and technical know-how have been integrated with other fashionable subjects such as literature and moral philosophy, again appealing to wide audiences within the upper echelons of British society. The new direction for the Royal Institution proved successful in garnering increased subscribers, and thus more funds for the institution; however, in its own way, this new vision proved to be as contentious as Rumford’s more egalitarian plan. Many proponents of the Royal Institution, particularly those affiliated with the burgeoning scientific community, were unsettled by the blatant appeals to fashion and audibly expressed their concerns over the large numbers of women, dandies, dilettantes, and attention-seekers who were attending the lectures. They worried



that the institution was lessening the rigor of the scientific lessons in order to appeal to such audiences, effectively turning the lectures into dumbed-down entertainments.

If working-class men were given less of a place in the Royal Institution after Rumford's departure, the institution was consistently open to women, specifically ladies from the upper and middle classes. Both visions of public science conceived of the Royal Institution as a place where women could educate themselves through public lectures, although they were not permitted to engage with other facets of the organization such as management or scientific research. In Rumford's original plan he envisioned women being allowed to be both proprietors (founding contributors) and subscribers to the public lectures, but they were excluded from the possibility of participating in the management of the institution, as male proprietors were allowed to do (qtd. in Jones 137).<sup>46</sup> In a later revision of the subscription scheme in 1803, it was noted that mothers and daughters in the same family could share a subscription (qtd. in Jones 208-209). The leadership of the Royal Institution was also consistent in arguing that women were not expected to gain a professional education at the institution but that the public lectures might fill a lingering gap in women's education. Royal Institution lecturer Dr. Young is quoted as saying, "The Royal Institution may in some degree supply the place of a subordinate university to those whose sex or situation in life has denied them the advantage of an academical education in the national seminaries of learning" (Young 3).<sup>47</sup> In 1810, Humphry Davy reiterated

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<sup>46</sup>In the original Rumford plan, "[i]t was decided that ladies should be admitted as proprietors [original subscribers] and subscribers, and entitled to all privileges, 'excepting only that ladies will not be called upon to take any part in the management with the officers of the Institution'" (qtd. in Jones 137). To my knowledge no women became proprietors; they were much more active as subscribers.

<sup>47</sup>Young also claims that a "considerable portion of my audience, to whose information it will be my particular ambition to accommodate my lectures, consists of that sex, which, by the custom of civilised society, is in some measure exempted from the more laborious duties that occupy the time and attention of the other sex. The many leisure hours, which are at the command of females in the superior orders of society, may surely be appropriated, with greater satisfaction, to the improvement of the mind, and to the acquisition of knowledge, than to such amusements as are only designed for facilitating the insipid consumption of superfluous time" (3). This passage

the intended scope of women's education at the Royal Institution by claiming that "[o]ur doors are to be open to all who wish to profit by knowledge; and I may venture to hope that even the female part of our audiences...will honour the plan with an attention which is independent of fashion or the taste of the moment" (qtd. in Jones 297).<sup>48</sup> He also clearly states that "[i]t is not our intention to invite them to assist in the laboratories, but to partake of that healthy and refined amusement which results from a perception of the variety, order, and harmony existing in all the kingdoms of nature" (qtd. in Jones 297). The Royal Institution thus invited women to participate in the public science lectures, but their involvement in more professional aspects of the institution, such as management or research, was strictly limited—a point that the Royal Institution repeatedly made to male audiences made anxious by women's increasing presence.

So the Royal Institution was indeed an elite and fashionable institution, in addition to a philanthropic and experimental one. And these appeals to wide, if relatively wealthy, audiences were enormously successful. In 1802, during the lecture session, there were daily lectures offered to lifetime and annual subscribers as well as to audiences paying for a single lecture when space allowed. Scientific professors Davy and Young were scheduled to give fifty lectures apiece on subjects taken from chemistry, mechanics, physics, and natural philosophy. To these were added talks by temporary lecturers on popular scientific topics such as botany and physiology as well as lectures on non-scientific topics like moral philosophy and painting.<sup>49</sup> The lecture theater could

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shows that Young did attempt to tailor his lectures for leisured female audiences. This further suggests that he positioned scientific study as a cure for fashionable consumption rather than another form of it.

<sup>48</sup>This comment from 1810 would suggest that Davy and others who worked for the Royal Institution were familiar with the perception that female audiences were there primarily for fashionable reasons. Davy's remark, asking women for an "attention which is independent of fashion or the taste of the moment" hints that the Royal Institution professors attempted to lessen this emphasis and offered alternative rationales for women's scientific education.

<sup>49</sup>Simond describes the variety of lectures offered at the Royal Institution: "Several other eminent men deliver lectures at the Royal Institution; Mr. Pond on astronomy, Mr. Allen on mechanics, Dr. James E. Smith on natural history. These sciences are not, however, so fashionable as chemistry; they are not susceptible of any brilliant

hold up to 900 individuals and attendance could spike to 600-800 visitors for popular lecturers (Jones 205, 265). The audience was comprised of both men and women, with a heterogeneous mix of ministers, lords and ladies, bluestockings, dandies, mothers with children, and scientifically minded men. The success of the institution was certainly indebted to the novelty of the institution, the fashionable associations of the founding contributors and audiences, and the general taste for science in the time period,<sup>50</sup> but as many contemporaries and historians argue it was also aided by the individual lecturing talents of its professors, particularly Humphry Davy. In what follows, I analyze Davy's lectures on chemistry and examine how he presented the discipline as a public science that was accessible to a wide variety of non-experts.

### **Cultivating an Expansive Scientific Public: Humphry Davy's Lectures**

An analysis of the early leadership of the Royal Institution shows that there was no single uncontested vision for the Royal Institution. The managers advanced their preferred agendas for distributing scientific knowledge, each with a different conception of which audiences should participate and how they would benefit from public science. In this section, I analyze the enormously popular public science lectures of Humphry Davy, who managed to combine aspects of the leadership's disparate visions by appealing to expansive, yet fashionable, audiences. As a young chemist, Davy joined the Royal Institution as an assistant lecturer in 1801 when he was 22 years old. Early reviews of his lectures show the promise of his oratorical skill:

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exhibitions; there is no noise, no fire,—and the ampitheatre never fills, but for Davy. The resources of chemistry, to recal [sic] or keep up the attention of a mixt [sic] audience, are infinite. A small bit of potassium thrown in a glass of water, or upon a piece of ice, never fails to excite a gentle murmur of applause" (1: 44).

<sup>50</sup>Davy's brother, John Davy, explains how the historical moment contributed to his brother's success: "The Royal Institution was a new experiment. Novelty in itself is delightful, especially to people of rank and fortune, who at that time, in consequence of the Continent's being closed, owing to the war, must have been delighted to have had opened to them a new and unexpected source of interest, fitted to amuse those who were suffering from *ennui*, and to instruct those who were anxious for instruction. The Royal Institution, moreover, was the creation of a large number of influential persons, both in the higher ranks of society and of science. This alone might have sufficed to render it fashionable, and if fashionable, popular" (89).

The sensation created by his first course of lectures at the Institution and the enthusiastic admiration which they obtained, is at this period hardly to be imagined. Men of the first rank and talent, --the literary and the scientific, the practical and the theoretical, --bluestockings and women of fashion, the old and the young, all crowded, eagerly crowded the lecture-room. His youth, his simplicity, his natural eloquence, his chemical knowledge, his happy illustrations and well-conducted experiments, excited universal attention, and unbounded applause. (qtd. in Jones 328-329)

Focusing on Davy's Introduction to a course of lectures on chemistry from 1802, I argue that, in addition to oratorical excellence, Davy offered his audiences an expansive view of public science—one that connected diverse public interests with the new field of chemistry. By positioning chemistry as a science that held public value as well as individual interest for heterogeneous audiences, Davy was able to capture the interest of “men of the first rank and talent--the literary and the scientific, the practical and the theoretical,--bluestockings and women of fashion, the old and the young.” A second analysis of one of Davy's less-successful contemporaries, Dr. Thomas Young, shows that other lecturers often had difficulty presenting fulsome accounts of what science could offer to various communities.



Figure 8: Illustration of Humphry Davy from *Famous Men of Science* (1889)

In particular, I examine Davy's "A Discourse Introductory to a Course of Lectures on Chemistry, Delivered to the Theatre of the Royal Institution, on the 21<sup>st</sup> of January, 1802." This lecture was subsequently published in April 1802 (Davy 309). In the written advertisement to the printed lecture, Davy explains that the introduction—the first lecture in a whole course—would not contain "minute information" (309) about chemistry—such information would be saved for later lectures. Instead, the bulk of the introductory lecture was designed to "excite feelings of interest concerning" the emerging discipline (309). I argue that Davy sought to inspire interest in chemistry by connecting the study of chemistry with the personal ambitions and public concerns of the audience.

Indeed, one of Davy's rhetorical talents was in connecting the study and application of chemistry with desire, utility, and personal identity. To begin, Davy argues that chemistry should not be viewed as a study divorced from personal interests and pleasures. Instead, he claims that chemistry is deeply interwoven with the audiences' individual and communal desires. He explains that "chemistry is not valuable simply in its connections with the sciences, some of which are speculative and remote from our habitual passions and desires; it applies to most of the processes on which we depend for the gratification of our wants" (315). To prove his point, Davy briefly describes how chemistry advances processes like tanning, dying, agriculture, and metallurgy, which produce the commercial products that audiences desire. Davy further links chemistry with the cultivation of "civilized society" when he explains how metallurgy has impacted audiences' lives:

The working of metals is a branch of technical chemistry; and it would be a sublime though a difficult task to ascertain the effects of this art upon the progress of the human mind. It has afforded to man the powers of defence [sic] against savage animals; it has enabled him to cultivate the ground, to build houses, cities, and ships, and to model much of the surface of the earth after his own imaginations of beauty. It has furnished

instruments connected not only with his sublime enjoyments, but likewise with his crimes and his miseries; it has enabled him to oppress and destroy, to conquer and protect. (316)

In this passage, Davy makes the art of metallurgy into high drama, articulating chemical manipulation of metals into forces capable of shaping human society. In Davy's telling, metallurgy, and by extension chemistry, is not an abstract or remote study but one that has the capacity to alter the human landscape by "building houses, cities, and ships," constructing works of beauty, or fashioning weapons that facilitate "crimes" and "miseries." This presents a view of science that is deeply enmeshed with human affairs.

Perhaps Davy's most impressive achievement, however, is his portrayal of multiple public scientific subjectivities, which offer diverse audiences an expansive selection of ways to engage with the new chemical discipline. Rhetorical scholarship has discussed the ways that rhetors can invoke or constitute certain subjectivities within the audience (Ede and Lunsford; Charland; Rice). By using discourse to "create subject positions from which people are invited to speak," rhetors can constitute new subject positions or call upon ones already familiar to the audience (Rice 46). Importantly, subjectivities are never single or universal, and often individuals can access multiple, occasionally overlapping subjectivities depending upon existing cultural patterns, material circumstances, and personal feelings.<sup>51</sup> I argue that Davy engages in a cultivation of multiple scientific subjectivities in his introductory lecture by identifying how various members of his audience could take up the study of chemistry. Building upon existing

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<sup>51</sup>In using the term subjectivity, I follow Rice's understanding: "[s]ubjectivity is one of those topics that has a long, complex history in critical theory. We generally recognize that subjectivity is not a state of self-presence or consciousness, nor is subjectivity something solidified over time. It is an articulation of multiple narratives, practices, and apparatuses that coalesce at any given moment. Michael Warner cautions against theorizing a single universal subject at the expense of all others who are denied entrance into the single public sphere ("Mass Public"). We do not only exist in one role or speak as only one kind of public subject. Among other things, I am simultaneously a college professor at a state school, a homeowner, a registered Democrat, and a Jew. I enact multiple subjectivities when speaking in/as any of these roles. Moreover, the meanings and readings of a Jewish public subject or a state employee (or any other role I may temporarily inhabit) exist through discourses and apparatuses (like institutions and cultural practices) that precede and exceed me as an individual" (Rice 44-45).

subject positions, Davy manages to offer flexible yet substantive possibilities for how his audience might engage in the study of chemistry.

Offering multiple possible subject positions, Davy describes how the manufacturer, the artist, the agriculturalist, the businessman, the person of wealth and fashion, the literary intellectual, and the man of science might all variously perform and benefit from chemical study. For instance, appealing to the economic interests of the artist, Davy argues that chemistry will decrease his labor: “the artist who formerly affected to despise scientific principles, because he was incapable of perceiving the advantages of them, is now so far enlightened, as to favour the adoption of new processes in his art, whenever they are evidently connected with a diminution of labour” (322-323). For the “man of business, or of mechanical employment,” Davy suggests that chemical study could refine the mind: “the pursuit of experimental research may afford a simple pleasure, unconnected with the gratification of unnecessary wants, and leading to such an expansion of the faculties of the mind as must give to it dignity and power” (326). Addressing the “refined and fashionable classes of society,” Davy contends that the study of chemistry can act as an emotional and intellectual palliative:

[chemistry] may become a source of consolation and of happiness in those moments of solitude, when the common habits and passions of the world are considered with indifference. It may destroy diseases of the imagination, owing to too deep a sensibility; and it may attach the affections to objects, permanent, important, and intimately related to the interests of the human species. (326)

Speaking “[e]ven to persons of powerful minds, who are connected with society by literary, political, or moral relations,” Davy claims that “an acquaintance with the science that represents the operations of nature cannot be wholly useless” (326). He continues to explain how the intellectual study of chemistry

must strengthen their habits of minute discrimination;...From observing in the relations of inanimate things fitness and utility, he will reason with deeper reverence concerning

beings possessing life; and perceiving in all the phenomena of the universe the designs of a perfect intelligence, he will be averse to the turbulence and passion of hasty innovations, and will uniformly appear as the friend of tranquility and order. (326)

These passages illustrate Davy's skill in acknowledging different populations in his audience and his arguments for how chemistry might prove advantageous for each kind of person.

Importantly, Davy is not advocating for members of the audience to become professional experimental philosophers. On the contrary, he advises his audience on how the study of chemistry might benefit their existing occupations (such as the artist), lessen their boredom (such as the fashionable set), and refine their characters (such as those already acknowledged as intellectuals). While some benefits are applicable only to a narrow set of students, others like providing a "source of consolation and of happiness in those moments of solitude" and "strengthen[ing] their habits of minute discrimination" are available to a wide population. In this manner, Davy establishes myriad benefits, both tailored for specific individuals and available across the spectrum of audience members.

Moreover, Davy's subject positions do not simply describe personal benefits but also "invite certain modes of encountering and interacting with others" (Asen 193). Davy draws upon existing subject positions but suggests, in addition, that the study of chemistry might stretch these given roles, enabling new characteristics, activities, and modes of engaging with other audiences. An example can be found in Davy's description of the agriculturalist, who through "the knowledge of the composition of the soils, of the food of vegetables, of the modes in which their products must be treated" (316) can better cultivate his land. This is not simply an act of private gain. On the contrary, Davy claims that the agriculturalist's "exertions are profitable and useful to society, in proportion as he is more of a chemical philosopher" (316). In fact, Davy contends that the increase in agricultural yield will also result in increased recognition and appreciation from the rest of society. Through the use of chemistry, "the character of the



agriculturist has become more dignified and more refined. No longer a mere machine of labour, he had learned to think and reason. He is aware of his usefulness to his fellow-men; and he is become at once the friend of nature and the friend of society” (316). Davy’s proposed scientific subject positions thus have a public component. By using chemistry to refine one’s character, to increase the capacity of one’s intellect, and to improve mechanical and labor efficiency, individuals who study chemistry have the ability to better contribute to society, to better recognize the contributions of others, *and* to have their own contributions recognized. Davy argues, perhaps optimistically, that “[b]y means of knowledge and the useful arts, the great whole of society should be ultimately connected together...they should act as the children of one great parent, with one determinate end, so that no power may be rendered useless, no exertions thrown away” (323).

Davy’s introduction to his course on chemistry thus attempts to excite diverse audience interest, not only in the subject of chemistry but in the prospect of personal and public enrichment through scientific education. He has offered heterogeneous audiences a glimpse of what subject positions they might adopt or how their current subjectivities might be extended and refined through the course of study. Moreover, Davy has positioned chemical education as an active and creative endeavor, not one that is passively perused without practical application.<sup>52</sup> Students of chemistry stand to gain material benefits, positive personal attributes, and social recognition even in the early stages of study, which will continue to grow with advanced scholarship. In his account of his brother’s lectures for the Royal Institution, John Davy claims that audiences were eager to adopt the subjectivities, along with the perceived positive attributes,

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<sup>52</sup>Emphasizing the active nature of scientific study, Davy argues that “[s]cience has given to him an acquaintance with the different relations of the parts of the external world; and more than that, it has bestowed upon him powers which may be almost called creative; which have enabled him to modify and change the beings surrounding him, and by his experiments to interrogate nature with power, not simply as a scholar, passive and seeking only to understand her operations, but rather as a master, active with his own instruments” (319).

that Davy offered to them. He suggests that “in giving them [the audience] credit for acquirements, no doubt many flattered themselves they possessed them, or had a desire excited to attain them” (93). Through his lectures Davy thus offered a vision for audiences about how the study of chemistry could make them more efficient, contented, and praiseworthy individuals and how those individual benefits could contribute to greater public works. Moreover, the presentation of multiple, perhaps overlapping public science subjectivities offers an expansive account of public science, seen as a collective enterprise open to most individuals and capable of aiding the public in sundry ways.

Reviewing the lectures of one of Davy’s contemporaries, Dr. Thomas Young, shows that not all Royal Institution lecturers shared a similar view for the public aims of the institution. Although Young maintained that his lectures fulfilled the professed ends of the Royal Institution—“to direct public attention to the cultivation of elementary doctrines of natural philosophy, as well speculative as practical” (Young 2)—his courses exhibited a markedly different tone, one that audiences found less inviting than Davy’s. I argue that the contrast between Davy’s and Young’s lectures provides further evidence for why audiences responded so favorably to Davy’s expansive vision of public science.

Hired after Davy in 1801, Young (at 28 years old) had already presented scientific papers to the Royal Society, and his experimental acumen earned him a place as Professor of Natural Philosophy, Editor of the Journals, and Superintendent of the House at the Royal Institution (Cantor 90). In historical accounts, Young’s contemporaries acknowledge his significant erudition about a wide variety of scientific fields, including mechanics, hydrodynamics, and physics; however, most agree that his teaching style was not suited for public audiences. Davy’s biographer, Dr. Paris, contends that “Dr. Young, whose profound knowledge of the subjects he

taught no one will venture to question, lectured in the same theatre [as Davy], and to an audience similarly constituted to that which was attracted by Davy, but he found the number of his attendants diminish daily, and for no other reason than that he adopted too severe and didactic a style” (qtd. in Jones 240). One of Young’s acquaintances from Cambridge similarly suggested that

His language was correct, his utterance rapid, and his sentences, though without any affectation, never left unfinished; but his words were not those in familiar use, and the arrangement of his ideas seldom the same as those he conversed with. He was, therefore, worse calculated than any man I ever knew for the communication of knowledge. I remember him taking me with him to the Royal Institution to hear him lecture to a number of silly women and dilettante philosophers. But nothing could show less judgment than the method he adopted; for he presumed like many other lecturers and preachers, on the knowledge and not on the ignorance, of his hearers. (qtd. in Jones 233)<sup>53</sup>

Although Young certainly adopted a “didactic” style, I argue that Young’s lectures also failed to excite audience interest because they did not provide the same expansive view of scientific study seen in Davy’s lectures.

When taken as a whole, Young’s lecturing style portrays a different view of public science than Davy’s, one that was much less conducive to amateur practice. In the introduction to his course of lectures on mechanics, published in 1807, Young offered audiences an outline of the course, providing information about his goals for the lectures as well as what he expected

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<sup>53</sup>An investigation of Young’s lectures and writings for the Royal Institution shows that he was aware of his public audience and their need for more introductory and amusing presentations of science. Despite this awareness, however, Young continued to have difficulty balancing his desire for scientific rigor with a presentation style suited for a heterogeneous audience that included numerous individuals who were unfamiliar with scientific theories. In a prospectus for his course of lectures he states: “It would unquestionably be desirable that every syllable advanced should be rendered perfectly easy and comprehensible even to the most uninformed, that the most inattentive might find sufficient variety and entertainment in what is submitted to them to excite their curiosity, and that in all cases the pleasing, and sometimes even the surprising, should be united with the instructive and the important. But, whenever there appears to be a real impossibility of reconciling these various objects, I shall esteem it better to seek for substantial utility than temporary amusement; for if we fail of being useful, for want of being sufficiently popular, we remain at least respectable; but if we are unsuccessful in our attempts to amuse, we immediately appear trifling and contemptible. It shall, however, at all times be my endeavor to avoid each extreme” (Young 7-8).

audiences to gain from the course. Perhaps concerned about the perceived rigor of his courses, Young describes scientific learning as a long and arduous endeavor:

It requires the study of a considerable portion of a man's life to qualify him to be of use to mankind in any of them, and nothing can be more pernicious to individuals or to society than the attempting to proceed practically upon an imperfect conception of a few first principles only. In physic the wisest can do but little, and the ignorant can only do worse than nothing; and anxiously as we are disposed to seek whatever relief the learned and experienced may be able to afford us, so cautiously ought we to avoid the mischievous interference of the half-studied empiric. In politics and in religion we need but to look back on the history of kingdoms and republics, in order to be aware of the mischiefs which ensue when fools rush in where angels fear to tread. (Young 5-6)

This view of scientific study, or any academic study, privileges expert knowledge and positions the learner, somewhat derisively, as the “half-studied empiric.” Young’s language would even suggest that audiences should not attempt to use what they had learned in his lectures, as “nothing can be more pernicious to individuals or to society than the attempting to proceed practically upon an imperfect conception of a few first principles only.”<sup>54</sup> Though Young’s comments are not without merit, they advance a perspective on learning that is less welcoming of public or amateur participation.<sup>55</sup> In contrast to Davy’s copia of suggestions for what new learners of chemistry might do with their scientific study, to the benefit of both individuals and society, Young’s introduction to mechanics provides little incentive or utility for those who do

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<sup>54</sup>Similarly, Young warns the unlearned away from attempts at invention: “We may also be able to render an important service to society, and to confer a still more essential benefit on individuals, by *repressing the premature zeal of unskilful [sic] inventors*. We need only read over the monthly accounts of patents, intended for securing the pecuniary advantages of useful discoveries, in order to be convinced what expense of time and fortune is continually lavished on the feeblest attempts to innovate and improve. If we can be successful in convincing such inconsiderate enthusiasts of their real ignorance, or if we can show them, that even their own fairy ground has been preoccupied, we may save them from impending ruin, and may relieve the public from the distraction of having its attention perpetually excited by unworthy objects...” (4-5, emphasis mine). Here, Young aims to benefit the public by saving them from the enthusiasm of unskilled inventors.

<sup>55</sup>To be fair, Young did suggest that benefit could be wrought from a non-exorbitant amount of scientific study: “Unfortunately, the hands that execute are too often inadequately supported by the head that directs; and much labor is lost for want of a little previous application to the fundamental doctrines of the mechanical sciences. Nor is any exorbitant portion of time or industry necessary for this purpose; for it happens singularly enough that almost all practical applications of science depend on principles easily learnt” (4). In general, Young’s comments seem to favor more study over less. Certainly, his perspective on public science study seems less welcoming to amateurs than Davy’s.

not intend to become experts in the field. Moreover, he argues that those who are truly interested in scientific study do not need long-winded explanations of science's worth:

Those who possess the genuine spirit of scientific investigation, and who have tasted the pure satisfaction arising from an advancement in intellectual acquirements, are content to proceed in their researches without inquiring at every step what they gain by their newly-discovered lights, and to what practical purposes they are applicable; they receive a sufficient gratification from the enlargement of their views of the constitution of the universe, and experience in the immediate pursuit of knowledge that pleasure which others wish to obtain more circuitously by its means. (Young 2)

Davy offers a similar reasoning for pursuing scientific study—enjoyment in the “advancement in intellectual acquirements.” However, this is by no means a reason that is applicable to all who might be in attendance at a public lecture, nor is this reason the sole and “sufficient gratification” for those who do gain pleasure in prolonged study. Young seems to have difficulty imagining public interest and public engagement with science that does not have expertise as an end goal. Unlike Davy, he does not seem to see, or offer the vision for his audience to see, how a little scientific knowledge might be useful for diverse audiences. He does not account for the material, social, economic, or moral benefits that the agriculturalist, the artist, or the fashionable lady might gain from a course of lectures. His vision of science and of scientific study appears too closely linked to his own sense of self—a scholar who has spent years learning his subject. Young was criticized by his contemporaries for presuming too much knowledge in his audience and employing too pedantic a style: to this I would add that Young presumed too narrow a scope for what public audiences might do with scientific study. In comparison with Davy, he did not offer or excite expansive public engagement with science—one that enabled multiple and varied uses of scientific study (or public science subjectivities) right from the first course of lectures.

## **Contested Public Science: Audience Responses and Representations**

As discussed in the previous two sections, the Royal Institution became a popular and fashionable space for non-experts to hear a lecture on mechanics, chemistry, or natural philosophy and for knowledgeable individuals to learn about the latest scientific discoveries of the institution's lecturers. Certainly, the leadership of the institution privileged wealthy audiences who could financially support the institution as well as lend polite credibility to the managers and professors. Even with this preference, the institution, particularly Davy's lectures, worked to cultivate a heterogeneous audience, with multiple public scientific subjectivities, that could variously benefit from the study of science. This reasonably expansive view of public science suggested that non-experts from a variety of occupations and social strata could augment their personal lives and contribute to the public good through increased knowledge and application of science. This section examines audience responses to the institution and argues that the persistent characterization of the institution and its audience members as fashionable winnowed the vision of public science that the institution could offer. By insisting that the audience members were fashionable in a pejorative sense—frivolous, trifling, and unintellectual—opponents of the Royal Institution encouraged a problematic opposition between rigorous scientific education and superficial scientific entertainment. This division obscured the varied and interwoven benefits of instruction, amusement, consolation, and refined sensibilities offered by Davy. This division further delegitimized public science by characterizing scientific education for those who did not intend to pursue advanced study as a frivolous activity with limited economic, social, or public benefit.

Despite Davy's attempt to cultivate multiple public science subjectivities, his lectures alone were insufficient to constitute and maintain an expansive view of public science. In the

case of the Royal Institution, the actions and comments of the audience served to inflect meanings associated with the public science lectures and impacted whether individuals chose to see themselves as part of an expansive scientific public.

So what did audiences think of the Royal Institution and what representations did they circulate? In speaking particularly about the public science lectures, most audiences seemed to consider the popularity of the institution to be as noteworthy as the scientific principles and technological innovations on display. Audiences seemed fascinated by, and often contemptuous of, each other. In an account from his travels to London (1805-1806), American Benjamin Silliman commented on the audience for a lecture about the “general properties of matter.” Offering little information about the science of the lecture, Silliman did note that “the audience was composed of people of all ages, and both sexes; about half were females and most of these were young ladies” (3: 91). Silliman did not seem bothered by the high numbers of ladies in the audience and instead commented that

“[t]here seems to be at present in London, a disposition to encourage a taste for the sciences, by giving them a popular air; there can be no danger that the dignity of science will be degraded so long as this duty is committed to able hands, and it would certainly be happy if the attractions of literature and scientific recreation could effectively decoy the fashionable people of London away from scenes of amusement, where delicacy is perpetually violated, all serious impressions are banished, and frivolity and thoughtlessness take their place.” (3: 91)<sup>56</sup>

A less generous description of the Royal Institution lecture audience can be found in the work of Robert Southey<sup>57</sup>, whose report emphasizes the fashionable aspects of the lecture audience:

The arts and sciences are now taught in lectures to fashionable audiences of both sexes; and there is a Royal Institution for this purpose, where some of the most scientific men in the kingdom are thus unworthily employed. I went there one morning with J. and his wife,--whom you are not to suspect of going for any other purpose than to see the place.

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<sup>56</sup>Even though Silliman does not equate women’s participation with fashion in this comment, we can still see a derision towards fashion and activities deemed fashionable.

<sup>57</sup>Southey does not date his trip to the Royal Institution but his printed book of letters was first published in 1807.

Part of the men were taking snuff to keep their eyes open, others more honestly asleep, while ladies were all upon the watch, and some score of them had their tablets and pencils, busily noting down what they heard, as topics for the next conversation party. (3: 284-85)

These reports of public science lectures resemble theatrical performances where the audience displays become part of the event's entertainment. Scholar S. Michael Halloran suggests that rhetoricians should pay attention to the "lived experience" surrounding discursive texts as these can often "overwhel[m] the text, like a dramatic performance at which the splendor and animation of those in the audience attracts more attention than the doings on stage" (6). Halloran claims that, in such moments, the audience is "self-consciously present to each other as well as to whatever it is that has brought them together" (5) and that their actions and perceptions of each other have the ability to shade the meanings of the event (14). In the case of the Royal Institution public lectures, we certainly see that the actions and associations of the audience added to the spectacle of the science displays—the hiss and spark of potash combustion blended with the animated pencil scratching of ladies and the fashionable snorting of men taking snuff. As can be seen in differences between Silliman and Southey's recollections, however, the perceptions of audience behavior could differ substantially and thus radically shift how audiences perceived the value and meaning of the public science lectures. Certainly, multiple forms of audience engagement occurred, ranging from diligent study to boredom to gawking. Yet representations of the Royal Institution audience, like Southey's, which viewed lectures as negatively participating in fashion rather than ameliorating fashion's more pejorative aspects, became increasingly circulated.

In particular, it is important to dwell on the gendering that often occurred in the accounts of the Royal Institution lectures and how this impacted impressions of public science. The wealthy and fashionable associations of both the institution's leadership and audience



predisposed the institution to feminized representations. Moreover, in comments about the lectures, there is persistent attention given to the intensity of female audiences' responses to the lectures and an association of these behaviors with fashionable endeavors. Critically, women's non-verbal and embodied responses to the lectures, such as note taking, are seen as curious and thus become points of interest and sites of interpretation for other audience members. For example, Frenchman Louis Simond, like Silliman and Southey, commented on the gendered behavior of those present at the Royal Institution in his travel journals (1810-1811): "More than one half of the audience is female, and it is the most attentive portion. I often observe these fair disciples of science taking notes timidly, as by stealth, on small bits of paper" (1: 43). Initially, Simond considers women's interest in science to be trifling and harmless, even desirable in those wealthy enough to live a life of leisure; however, upon returning to the Royal Institution a year later and finding the lecture halls even more crowded by "the great and the fair," Simond begins to express fear over the growing fashionable enthusiasm for science: "It would be a matter of great regret if the allurements of science should at last prove inferior to those of fashion, and if future fame should be sacrificed to ephemeral success" (2: 196). Another account of the fashionable associations of the Royal Institution lectures comes from an 1802 letter by Francis Horner. In it he describes how he attended one of Davy's lectures on "animal substances," and how the audience was a "mixed and large assembly of both sexes to the number, perhaps, of three hundred or more" (1: 182). "It is a curious scene," Horner explains of the Royal Institution lecture, "the reflections it excites are of an ambiguous nature; for the prospect of possible good is mingled with the observation of much actual folly" (1: 182). Like Simond, Horner sees some value in mixed sex public science lectures: such lectures can advance "the association of female with masculine minds in the pursuit of useful knowledge" and they can potentially offer "another

domain of pleasing and liberal inquiry...within the range of polished conversation” (1: 182).

However, the actions of the mixed audience persuade Horner that the lectures are becoming the province of fashion. Despite the possibility for abstract good, Horner decides that, in actuality, the Royal Institution “audience is assembled by the influence of fashion merely; and fashion and chemistry form a very incongruous union” (1: 182). Thus, the increase in participation and interest in public science lectures, particularly by women, seems to convince other audience members that the lectures are becoming too fashionable. Popularity and fashion become collapsed, and women’s visible activities like note taking seem to provide evidence of fashionable interest, conceived as frivolous gawking rather than proof of varied interests or the earnest desire to educate themselves.<sup>58</sup>

This reductive perception of women’s interest as primarily fashionable becomes more problematic when it is contrasted with the rigorous scientific education found in masculine scholarly study. After Simond commented on women’s note taking behaviors, he explained that “no man does that” because “they already know the things taught, or care little about them!” (1: 43). Here, the women in the audience are portrayed as avid spectators—“the most attentive portion” of the audience—and their rapt response is compared with the relative solemnity or boredom of the men in the audience. Simond suggests that men in the audience are already proficient with the scientific information discussed or that they are dilettantes themselves, not

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<sup>58</sup>A more expansive view of women’s interest in chemistry and the Royal Institution public science lectures can be seen in Jane Marcet’s *Conversations on Chemistry* (1805), an instructional text aimed at female audiences who wished additional study: “On attending, for the first time, experimental lectures, the author found it almost impossible to derive any clear or satisfactory information from the rapid demonstrations which are usually, and perhaps necessarily, crowded into popular courses of this kind. But frequently opportunities having afterwards occurred of conversing with a friend on the subject of chemistry, and of repeating a variety of experiments, she became better acquainted with the principles of that science, and began to feel highly interested in its pursuit. It was then that she perceived, in attending the excellent lectures at the Royal Institution, by the present Professor of Chemistry, the great advantage which her previous knowledge of the subject, slight as it was, gave her over others who had not enjoyed the same means of private instruction. Every fact or experiment attracted her attention, and served to explain some theory to which she was not a total stranger; and she had the gratification to find that the numerous and elegant illustrations, for which that school is so much distinguished, seldom failed to produce on her mind the effect for which they were intended” (Preface para. 2).

really caring about the science but intrigued by the spectacle of the Royal Institution. Simond continues: “public lectures are only useful to those who know little and aspire to little. Real learning is only acquired by solitary study” (1: 43). Comments like these position the Royal Institution lectures as distinct from “real learning” and as fashionable amusements for those who “know little and aspire to little.” Another such division between rigorous science and superficial scientific recreation is constructed in an 1803 article from the *Edinburgh Review*. Seeking to undercut the research theories of Dr. Thomas Young, one of the lecturers at the Royal Institution, author Henry Brougham denigrates the Royal Institution as catering to women and dilettantes<sup>59</sup>:

It is difficult to argue with an author whose mind is filled with a medium of so fickle and vibratory a nature. Were we to take the trouble to refute him, he might tell us, *My opinion is changed, and I have abandoned that hypothesis, but here is another for you.* We demand if the world of science which Newton once illuminated is to be as changeable in its modes as the world of taste, which is directed by the nod of a silly woman or a pampered fop? Has the Royal Society degraded its publications into bulletins of new and fashionable theories for the ladies who attend the Royal Institution? *Proh pudor!* Let the Professor continue to amuse his audience with an endless variety of such harmless trifles, but, in the name of science, let them not find admittance into that venerable repository which contains the works of Newton, and Boyle, and Cavendish, and Maskelyne, and Herschel. (Francis “ART. XVII” 452)

Here, we see a striking contrast between fickle taste, silly women, and the pampered fops associated the Royal Institution and the venerable repository of science found in the Royal Society. Although the Royal Institution was never designed to compete with learned communities like the Royal Society, it did advance the theory that diffusion of scientific knowledge to public audiences could result in public good. Davy, for his part, spent enormous effort describing and cultivating public science subjectivities for those across social strata who could variously benefit, both individually and collectively, from increased chemical knowledge. Representations such as this one from the *Edinburgh Review*, however, collapse the variety of

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<sup>59</sup>This charge is similar to the one made by Dr. Young’s acquaintance who claimed that Young was lecturing to “a number of silly women and dilettante philosophers” at the Royal Institution (qtd. in Jones 233).

public science benefit and argue that public science lectures, like those found at the Royal Institution, are “harmless trifles” fit only to amuse feminized audiences. Rather than an expansive community where amateurs might profit from scientific knowledge—without necessarily aspiring to become experts—we see a proposed binary between those with unquestioned expertise and those who merely flirt with scientific knowledge.

## **Conclusion**

At stake in representations like these is the relevance of public science. Can there be sustained public interaction with scientific knowledge that admits the participation of non-experts, men and women alike? Can there be a spectrum of public science participation in between scientific expertise and frivolous amusement? Professors like Davy argued that expansive public science engagement was desirable, even profitable to diverse individuals like the artist, the literary intellectual, and the fashionable lady. Moreover, individual scientific application in diverse social and economic spheres could contribute to the collective good. However, the visible—even spectacular—popularity of the Royal Institution public science lectures prompted reductive representations that positioned scientific experts on one side and frivolous dilettantes on the other. Although fashionable representations of the public science lectures, and by extension the Royal Institution, were not the sole characterizations of the institution, they circulated widely and effectively devalued the participation of women and men who did not have the opportunity or the inclination for prolonged scientific study.



Figure 9: View of the Royal Institution (2011)

The story of the Royal Institution public lectures did not end in the early nineteenth century. In fact, the Royal Institution and its public lectures continue to operate in Albemarle Street in London as of 2014, although much less prolifically and much less identified with fashionable female audiences than its early nineteenth-century counterpart. However, the case study of the Royal Institution at the turn of the nineteenth century illustrates a problematic tension that emerged when a public science project became massively popular, seemingly open to anyone in the middle and upper classes with scientific interest. This case highlights the difficulties with cultivating and sustaining an expansive scientific public, one with the space and tolerance to allow a spectrum of engagements ranging from superficial gawking to prolonged study, and one that valued scientific interest even when it was not on a pathway to expertise.

## CONCLUSION: SPECULATIONS ABOUT SPECTACLES

“All speakers and writers who aspire to intervene in society face the task of constructing a responsive public.”

Susan Wells

Throughout writing this dissertation, I have been inspired by the above quotation by rhetoric and composition theorist Susan Wells. In her article “Rogue Cops and Health Care: What Do We Want from Public Writing?” Wells critiques contemporary public writing pedagogy that directs students to write “generic” public compositions, such as letters to the editor, which have little chance of being acknowledged and less chance of prompting a response (238). She argues that writing for diffuse and abstract public audiences is akin to writing for “no audience at all” (328). Instead, Wells suggests that students need experience not only in writing for complicated, fragmented, and historically contingent publics but also in recognizing that public writing has an obligation to construct the conditions that enable audiences to answer back.

Like Wells’s research on contemporary public writing pedagogy, my own research pays attention to the ways that communities can perform and teach effective public advocacy, particularly public science advocacy. And like Wells, I argue that public writing requires not just the publication of a message or the appeal to a public but the cultivation of circumstances that enable audiences to answer and act. Effective public science advocacy necessitates the construction of a responsive scientific public.

I further suggest that the eighteenth century in Great Britain offers a particularly useful case study of public science advocacy. This time period represents a historical moment when public audiences responded, enthusiastically and in great numbers, to science popularization

attempts. As seen in the previous chapters, public audiences during this era embraced scientific study and practices even if they lacked the means or desire to join specialist communities like the Royal Society. Instead, public audiences engaged in public science—an open and accessible form of science participation outside of legitimate scientific experimentation. They further used their public science participation to collectively negotiate how science might intersect with matters of public concern, such as women’s education, conversation, and courtship. Critically, I argue that the effectiveness of public science advocacy in the eighteenth century was, in part, due to the efforts of science popularizers and enthusiasts to encourage diverse audience response. Science advocates did not simply distribute scientific information, nor were science popularization efforts limited to simplifying complex information. Instead, science advocates encouraged audience uptake of scientific principles and practices by offering pathways and incentives for public science participation. I argue that science popularizers tailored scientific demonstrations to multiple, heterogeneous audiences, thereby suggesting ways that scientific study might variously inform the practices and identities that audiences already cared about. Further, audiences for science popularizations modeled public science practices and offered discursive and embodied arguments for how others might also utilize science, even if they were not scientists. In this manner, science advocates, both popularizers and public science participants, helped to construct a responsive scientific public interested in integrating science into their daily conversations and conduct. In this dissertation, I have particularly pointed to the role that public science spectacles played in attracting attention to science, promoting increased circulation of novel scientific theories and technologies, and creating ambiguous spaces where audiences could experiment with incorporating scientific novelties into more familiar aspects of public culture.

In this conclusion, I would like to further suggest that the study of public science in the eighteenth century might have practical applications for contemporary public science advocacy. The enthusiastic public reception of science in the eighteenth century is perhaps something that current science advocates would like to repeat. Whereas eighteenth-century audiences attended public science lectures by the thousands, decorated their homes with scientific instruments, and discussed the latest scientific theories with friends and family, the contemporary moment is often marked by concerns over the public's lack of scientific interest and scientific literacy. Certainly, there are robust forms of contemporary public science such as popular science blogs, TED talks, and maker's faires, which are increasing in popularity due to developing communication technologies. However, science advocates still express concern about widespread scientific misconceptions and, at times, outright skepticism towards scientific research. An example of contemporary public beliefs about science and medicine can be seen in a March 2014 poll jointly given by the Associated Press and GfK Public Affairs & Corporate Communications. The Americans surveyed in this poll generally agreed with statements such as "Smoking causes cancer," with 82 percent of those surveyed saying they were extremely or very confident in the correctness of the statement, and "Inside our cells, there is a complex genetic code that helps determine who we are," with 69 percent extremely or very confident (GfK Public Affairs 2). However, other survey questions suggest uncertainty or unease with scientific research. For example, the individuals surveyed questioned the validity of statements such as "Childhood vaccines are safe and effective," with 53 percent extremely or very confident and 30 percent somewhat confident, and "The universe began 13.8 billion years ago with a big bang," with 21 percent extremely or very confident and 51 percent not too or not at all confident (GfK Public Affairs 2). These figures suggest that the individuals surveyed were uncertain about the nuances



of the scientific research statements or that they faced tensions in reconciling scientific research with information from other activity systems such as child care and religion. Upon reading this poll, I became curious not only for more information about Americans' scientific knowledge but also for information about their public science participation. How often did those surveyed discuss science with friends or family? How did they negotiate discrepancies in representations of scientific research in the media? And when did they find themselves using their scientific knowledge throughout the course of their daily activities? In other words, I am curious about how contemporary Americans translate their knowledge of science into actions, particularly social and public actions.

Despite the considerable historical differences between eighteenth-century Great Britain and twenty-first century America, I would like to suggest that contemporary public science advocacy efforts could benefit from some of the rhetorical strategies seen in the eighteenth century. Individuals in the eighteenth century similarly experienced difficulties in making sense of rapidly changing scientific advancements and struggled to integrate science within public culture. However, I argue that eighteenth-century public science audiences benefited from a robust network of public science texts and performances that offered opportunities to learn *and* models for public science participation. Eighteenth-century public science advocates encouraged audiences to not only study science but to put their scientific knowledge into action for a variety of individual and public ends. Critically, I argue that public science spectacles were especially productive in creating spaces for audiences to play with scientific novelties and entertain different ways that science might be incorporated into their lives. The exploratory and ambiguous moments constituted by public science spectacles did not just present scientific

information to audiences but offered moments for audiences to participate and respond, perhaps even to contribute additional models for public science engagement.<sup>60</sup>

In what follows, I would like to outline five dimensions of eighteenth-century public science and public science spectacles that I have made throughout my dissertation, including 1) the use of disruption in public science, 2) the range of public science spectacles, 3) the impact of the audience and extended context on the experience of public science spectacles, 4) the circulation of public science spectacles, and 5) the value of having diverse, networked uses for public science. While these dimensions apply to the rhetorical circumstances of the eighteenth century, it is my hope that they might also raise questions and offer potential resources for encouraging public science interest and participation in the present moment.

### **The Use of Disruption in Public Science**

My analysis of eighteenth-century public science spectacles demonstrates that science popularizers frequently utilized disruption, along with more plainspoken arguments, to advance public science knowledge and interest. As seen with the disruptive spectacles found in Benjamin Martin's popular instructional text *The Young Gentleman and Lady's Philosophy*, science popularizers would often emphasize disruption to capture audience attention and trouble previous beliefs about natural phenomena. For example, in Martin's text, the young characters' experiments with a solar microscope drastically realigned their previous perceptions of microscopic creatures. In one scene, the female character Euphrosyne marveled at the dramatic difference between looking at a scarab beetle's wing first unassisted and then when hugely magnified with a solar microscope. Whereas she had previously thought the insect "contemptible," she became awestruck when looking at the insect magnified with a solar

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<sup>60</sup>In her article, Wells suggests that "it might be helpful to see the public and public speech as questions, rather than answers" (327), and I contend that eighteenth-century public science spectacles presented this kind of questioning, exploratory approach.

microscope. She exclaimed that the magnified wing appeared as a “glorious Spectacle,” similar to displays of gold and diamonds (187). This example represents one of the many in which Martin, like other eighteenth-century popularizers, relied upon the disruptive and ambiguous quality of spectacles to make audiences reflect upon new sights, reevaluate old certainties, and entertain unfamiliar conceptions. If members of the burgeoning scientific community were using new scientific instruments to increase the precision of their observation and measurement, popularizers often used the same instruments to emphasize uncertainty about natural phenomena.

Notably, disruptive public science spectacles did not necessarily require the inclusion of new objects or technologies like the solar microscope. Instead, as an example from *The Newtonian System of Philosophy Adapted to the Capacities of Young Gentleman and Ladies* shows, disruption could occur when previously unconnected or dissimilar objects were placed together. In *The Newtonian System of Philosophy*, the narrator Tom Telescope displays this strategy when he calls upon a young girl in the audience to assist him in the display of a toy “pop-gun” (39). This demonstration, which showed a young girl performing a “school boy’s action” of operating a toy gun (39), disrupted familiar gendered expectations by juxtaposing two unassociated and notably dissimilar actors—the young girl and the toy pop-gun. The resulting disruption to the audience’s expectations for feminine behavior prompted the crowd to reflect upon the previously overlooked mechanism of the gun, which could be used to shoot a pellet across the room. Here, the disruption of the spectacle drew presence to the abstract and difficult to visualize concept of the “Spring in the Air,” which caused the toy pop-gun to fire (39).

The utility of disruption in eighteenth-century science spectacles raises questions about the potential efficacy of such strategies in contemporary scientific and technical communication. Future research might investigate the effectiveness of mixing disruptive spectacles with clear

instructional language in contemporary technical communication. Such research might examine whether disruptive rhetorical strategies could be helpful when advocating for controversial subject matter, e.g. troubling the links between vaccines and autism, or in high risk situations, e.g. when technical communicators need to draw audience attention to impending health risks. If disruptive rhetorical strategies do prove effective, then further research might be conducted on how to productively combine them with instructional language in technical communication. Future research might also be conducted on whether disruptive spectacles might facilitate contemporary public interest in scientific matters.

### **The Range of Public Science Spectacles**

Examining eighteenth-century public science spectacles also shows that science popularizers and participants cultivated a range of spectacular effects. As described in chapter one, “Women and the Emergence of Spectacular Public Science,” popularizers used strategies of excess, contradiction, and amplification to present scientific displays as spectacular. As the example with the pop-gun in *The Newtonian System of Philosophy* demonstrated, not all scientific displays were inherently eye-catching or disruptive. Science popularizers made rhetorical choices about how much to amplify the presentation of spectacle by combining strategies of excess and contradiction. In the case of the young girl and the pop-gun, the contradiction to gendered behavior helped to intensify the audience’s wonder at the use of air-pressure, or the “Spring in the Air,” to launch a projectile.

Similarly, when female audiences of public science spectacles sought to use their interest in science to advocate for their preferred forms of social behavior, as seen in chapter two, “Polite Science and the Spectacle of Women’s Learning,” they often moderated the spectacle of their displays. Bluestocking women such as Elizabeth Montagu and Hannah More made calculated

decisions about how over-the-top or muted their displays of scientific objects or learning would be. In the example of Montagu's famous feather screens, the bluestocking hostess deliberately created an ornate and visually stunning object that prompted conversation and encouraged accepted, yet not always enacted, ideals of diverse and harmonious social exchange.

Alternatively, Hannah More's use of scientific concepts in polite conversation showcased a more muted, though still spectacular, strategy. Although More encouraged women to study science and included elaborate scientific imagery in her own poetry to enhance the celebrity of her fellow bluestockings, she advised women to eschew technical scientific language. For More, a woman employing scientific jargon opened herself up to charges of pedantry or affectation from those in polite company. In such instances, the disruption to gendered behavior became too great, overwhelming the potential benefit that could be found in more muted spectacles of women's scientific learning. These examples show how eighteenth-century women moderated the intensity of their spectacular displays based on, for example, how far their demonstrations strayed from the boundaries of appropriate female behavior.

As seen throughout this dissertation, the eighteenth century exhibited a spectrum of public science spectacles, ranging from mildly surprising demonstrations to grand displays of excess. Given the variability of public science spectacles, perhaps it is not surprising that such spectacles inspired a multitude of audience responses, from thoughtful reflection to blatant curiosity to frantic consumption. Acknowledging the variance in public spectacles is an important step in accounting for why some public spectacles resulted in the cautious dwelling upon unfamiliar objects while others encouraged a dizzying desire for more novelty, such as seen in the anxious gazing described in Montagu's account of Ranelagh Gardens.

Turning to the contemporary moment, the range of public science spectacles in the eighteenth century raises questions about the varied rhetorical uses of spectacles in current scientific, technical, and public communication. My analysis of eighteenth-century spectacles has identified the strategies of excess, contradiction, and amplification in the construction and mediation of spectacles. Additional research on contemporary spectacles could locate further rhetorical strategies for producing a gradation of spectacular effects. Acknowledging the variety of spectacles as well as potential audience responses to spectacles would also suggest the need for new studies into the connections between spectacular demonstrations and audience affect. Can we develop a more nuanced sense about why some versions of spectacles might inspire amusement and fascination while others incite frenzy, fear, or anxiety?

### **The Impact of Audience and Extended Context on the Experience of Public Science Spectacles**

My investigation of women in the audience of public science spectacles, as well as the gendering of public science spectacles, provides evidence for the influence of audiences and the extended context on the experience of public science spectacles. As rhetorician S. Michael Halloran argues in his study of historical pageants, the experience of a spectacle depends not only upon the performance but also on the “lived experience” of the event (6). Halloran suggests that the lived experience of a spectacle can, at times, overwhelm the staged event, transforming a choreographed performance “into a side-show entertainment” (7). In this manner, the surrounding circumstances become important rhetorical features that color audience perceptions of the spectacle. Halloran uses his case study of the 1927 Battle of Saratoga Historical Pageant to argue that rhetorical scholars need to examine not just the textual records of historical performances but also accounts of the lived experience of watching performances.

An examination of public science spectacles in the eighteenth century similarly shows that audiences' perceptions of spectacles were frequently dependent upon the extended social and material contexts for those spectacles. An example of this can be seen in chapter one in a 1713 *Guardian* article account of women reading Fontenelle's *Entretiens sur la Pluralité des Mondes* aloud to each other while making jam. Part of the amusing sight for the reporter was in the placement of a philosophical text—containing spectacular accounts of astronomical phenomena—within the extended context of women making preserves: “It was very entertaining to me to see them dividing their Speculations between Jellies and Stars, and making a sudden Transition from the Sun to an apricot, or from the Copernican System to the figure of a Cheese-cake.” (Steele *Guardian* 2: 332). As material objects and activities—such as jam and jam making—are often inflected with social meanings, the reporter was responding to the inclusion of scientific study within the gendered and classed context of domestic production. I argue that part of the fun of public science spectacles was in the juxtaposition of unfamiliar objects, bodies, and practices. Although contradictory juxtapositions were certainly found within spectacular science displays, this example shows that audiences could also enjoy disruptive juxtapositions between the scientific demonstration and its surrounding context.

This example also demonstrates how science spectacles could facilitate public debates about the place of science within public culture. Public science spectacles were necessarily presented in contexts already imbued with social meaning, whether they be in lecture theatres, country fairs, or private homes. When audiences or the material circumstances of the context clashed with the presentation of science spectacles, as often occurred when women participated, it presented an opportunity for audiences to think about and discuss how novel scientific objects and perspectives might be integrated within existing places and practices.

Additionally, my research on public science spectacles argues for the ability of audiences to impact the meanings associated with public demonstrations. In the case of public science spectacles, the presence and actions of those in the audience could intensify the spectacle, draw other audience members' attention away from the demonstration, and/or dramatically impact meanings associated with the spectacular display. An example of audiences' rhetorical agency at the turn of the nineteenth century can be seen in chapter three, "Fashionable Science and Women Spectators at the Royal Institution." In this chapter, I describe how the public aims of the managers and professors of the Royal Institution were disrupted by the large numbers of women who attended the public science lectures and visibly took notes. Although the women did not speak as audience members, their presence and embodied actions were frequently noted by male audience members. These women and their embodied actions thus became associated with the Royal Institution and, in turn, began to influence community perceptions of the institution as frivolous and fashionable. Responding to the emerging fashionable associations of the Royal Institution lectures, some of the male audience members began suggesting that the public science lectures were becoming superficial scientific entertainments increasingly distanced from serious scientific study. Although this case suggests that audiences could wield considerable rhetorical agency, even without speaking a word, this also demonstrates that some audiences—and their characterizations of events—could be more powerful than others. I contend that this dimension of my dissertation would be useful for feminist rhetorical scholarship, enabling scholars to account for the possibilities as well as the limitations of women making arguments through their embodied actions as audience members. This would also suggest a need to attend to the multiplicity within audiences and the likelihood that certain audience perspectives could be more powerful than others. In the case of the Royal Institution, for example, the act of women's note



taking was increasingly perceived as a frivolous recreation rather than a sincere attempt to self-educate.

### **The Circulation of Public Science Spectacles**

Another dimension of my research points to the role of circulating public science spectacles in the cultivation of eighteenth-century public science. As argued by public sphere theorist Michael Warner, no one text can create or maintain a public. Instead, publics—as well as the activities that result from them and the meanings they produce—result from “the concatenation of texts through time” (90). In my research on public science, I draw upon Warner’s insight, tracing how circulating spectacles helped to constitute, maintain, and transform public participation in science. I further draw on rhetorical scholarship from Jenny Rice as well as Nathaniel Rivers and Ryan Web, in acknowledging that certain circulating texts inevitably had more power and authority than others while still paying attention to the influence of commonplace, and even mundane, texts such as informal conversations. Additionally, I agree with rhetorical theorists David Sheridan, Jim Ridolfo, and Anthony J. Michel’s contention that we must also analyze the circulation of multimodal texts such as embodied performances.

Building upon this public theory and public rhetoric research, my study contends that public science spectacles are valuable sites to analyze how public science texts circulated in the eighteenth century. They offer textual traces that show how varied audiences passed along and modified information about science as well as arguments about science’s role in public culture. In tracing the circulation of public science spectacles, I was intrigued to discover the extent to which audiences paid attention to each other and how this attention spurred additional circulations of public science texts. An example of how audiences’ perceptions of each other influenced the circulation of public science texts can be seen in the correspondence of Elizabeth

Carter, previously discussed in the introduction. In her letter, Carter asks her friend Catherine Talbot if she had ever interacted with a static-electricity generator:

Was you ever electrified? We have an itinerant philosopher here, who knocks people down for the moderate consideration of sixpence, and men, women, and children are electrified out of their senses. The fine ladies forget their cards and scandal to talk of the effects of electricity. The squires flock out of the villages to bring themselves and their dogs to be electrified; and the very boys and girls in the streets break their teeth with long hard words in describing the wonders of *tricity*. (*A Series of Letters* 129)

Carter's account of the spectacular display offers an example of how unfamiliar technologies sparked audiences' wonder and were often described and redescribed through informal conversations. This letter, however, also points to the importance of audiences' perceptions of each other, as discussed in the previous dimension. In addition to discussing the demonstration of the static-electricity generator, Carter seems as amused by her fellow audience members' reactions and their unaccustomed attempts to incorporate the science spectacle into their familiar routines, such as talking about electricity in polite conversation or bringing along the dog to a scientific display. The audiences' unfamiliar reactions, often bringing together previously unassociated actors, constitute their own spectacles, which are then, in turn, circulated by Carter's letter. This passage hints at the complex ways that public science spectacles facilitated the circulation of public science texts. Audiences could repeat the actual scientific display by recounting the demonstration to others, re-attending the demonstration, or recreating the material demonstration for their friends and family. Likewise audiences could recount other audiences' spectacular reactions, which occur both during the demonstration and afterwards. Moreover, these spectacular accounts are inevitably tinged by audience interpretations and evaluations of both the scientific objects and other audiences' reactions, which are compounded during each step of circulation.

In this fashion, public science participants such as Carter, the fine ladies, the squires, and the boys and girls in the streets can be seen to perform and circulate public science spectacles. Science popularizers and demonstrations certainly played a critical role in the distribution of scientific information, but audiences and their perceptions of each other were critical in the continued discussion and circulation of public science texts. I would argue that future research on public science, both in the eighteenth century and in the contemporary moment, should continue to investigate how audiences' watching each other contributes to the circulation and interpretation of public science. Future research on the circulation of public science spectacles could also investigate contemporary instances when audiences have the opportunity to watch each other in addition to receiving scientific information from popularizers. Such studies could identify contemporary sites that promote—or could promote—the continued circulation of scientific information and public science practices.

### **The Value of Having Diverse, Networked Uses for Public Science**

The final dimension of my work on public science and public science spectacles argues for the importance of having diverse and networked uses for public science. As seen throughout this dissertation, science popularizers from Benjamin Martin to Benjamin Franklin to Humphry Davy emphasized the myriad benefits of science, even for those not able or interested in pursuing advanced scientific study. Specifically appealing to women, popularizers argued that knowledge of emerging scientific fields such as natural history, astronomy, chemistry, mechanics, and botany could improve a woman's religious devotion, her topics of conversation, her social standing, her ability to engage with male relatives, her domestic manufactures, and her sense of mental well-being as well as reduce her boredom, her silliness, and her ignorance. Notably, popularizers made suggestions about which benefits might advantage certain individuals, such as

women of fortune and fashion enjoying the entertaining aspects of scientific study while young women could utilize scientific knowledge to develop more intellectual and companionable relationships with their husbands. Moreover, such suggestions posited a spectrum of public science engagement, with Humphry Davy, for example, arguing that even a little scientific study could benefit individuals as well as allow them to contribute to the collective public good. Audiences receiving such messages then adopted or modified these suggestions for public science participation, offering their own performances as circulating and reinforcing arguments about what others could do with science. As seen with the bluestocking women, audiences often utilized science for multiple, overlapping ends, such as Elizabeth Montagu who relied on science spectacles to entertain her guests as well as encourage particular forms of polite social engagement. The diverse uses of science thus promoted, for a time, a versatile public science that was open and accessible to participants across social, gendered, and classed spectrums. The multiple, overlapping benefits of scientific study and participation enabled public science engagements that could be adapted to different settings, different social groups, different individual tastes, and different ends.

I argue that the multiple avenues for public science participation helped to facilitate enthusiastic public response to science in the eighteenth century. Audiences had options about how to engage with public science, and the diversity of possibilities also meant that audiences had numerous opportunities to watch others interacting with public science. As historian G. S. Rousseau argues, the emerging fields of science influenced the “whole spirit of the age” and “not to endorse natural philosophy in some shape or form...was to be a misfit” (267). Additionally, the ubiquity of public science texts, performances, and practices, helped to forge networked interconnections between science and other eighteenth-century activity systems such as

education, religion, and courtship. These newly established links between unfamiliar and routine activities, such as using scientific practices to aid religious devotion, helped to increase the likelihood that public involvement with science would be repeated, circulated, and strengthened.

To conclude, I would like to end by offering a brief contemporary analogy for the widespread enthusiastic response to public science seen in the eighteenth century. This analogy helps to conceptualize how public science spectacles and the diverse and networked uses of science facilitated robust public engagement.

I would like to suggest that the public science interest and participation seen in eighteenth-century Great Britain resembles current American fascination with sports culture. Like eighteenth-century public science, contemporary American sports culture relies on spectacles to capture audience attention and to sustain that attention over the course of a season or longer. Sports franchises carefully craft public spectacles, including the games themselves, the light and sound effects in sporting arenas, and the inter-period shows, to provide a variety of entertainment that appeals to diverse audiences. However, I am more interested in how audiences for both eighteenth-century public science and American sports culture respond to public spectacles and continue to circulate and modify them within their daily lives. Like the audiences of eighteenth-century public science spectacles, contemporary sporting fans frequently become spectacles in their own right, as seen with the fair-like atmosphere of tail-gating, parties, and parades that often accompany sporting events. Equally important is the diversity of audience engagement with American sports culture. Certainly, spectacles are ubiquitous around sports stadiums, but they can also be found, to a different degree, in smaller venues. The earnest efforts of four year olds playing in a neighborhood T-Ball game or the rough play of a club rugby match present their own versions of sporting spectacles. The diversity of American interest in both

watching and playing sports further shows that sports culture is not restricted to those who plan to have professional sporting careers. Like public interest in eighteenth-century science, contemporary sports fans can have a range of interests and investments in sports culture. Contemporary sports fans have multiple, overlapping reasons for participating in sports culture, some of which are only tenuously related to athletics. In addition to the entertainment and recreation found in sports, participation in sports culture often provides a sense of individual or community identity, as seen when people visibly support a hometown team. Participation in sports culture additionally serves to mediate social relationships. For instance, watching a sporting event provides a rationale to meet with friends, talking about last night's game offers a polite topic of conversation for co-workers or acquaintances, and going to a game presents an appropriate venue for romantic courtship. Think of all the marriage proposals made, and then displayed on giant screens, at sporting events. Sports culture also benefits from a variety of gendered labor, such as mothers ferrying children to sports practice and professional cheerleaders entertaining fans on the sidelines, in the continued maintenance of public investment in sports. Perhaps because of this multifaceted participation in public sports culture, Americans seem more invested in public debates surrounding sports, such as legislative decisions regarding steroid use in professional sports and legal protections for women's college athletics.

I make this brief analogy between eighteenth-century public science and contemporary American sports culture to emphasize the role of spectacle in creating diverse and networked forms of public participation. In both examples, spectacles are constructed by popularizers and professionals but audiences are critical in the ongoing circulation and modification of spectacles, particularly in incorporating them within myriad facets of public life. I argue that the success of

both eighteenth-century public science and contemporary sports culture is in no small part dependent upon the diversity of public uses for these activities, the ability of those with a range of ability or interest to participate, and the interconnections created between multiple activity systems. In both cases, the repetition, circulation, and modification of public activities, particularly public spectacles, helps to constitute and sustain robust public involvement. Perhaps it might sound far-fetched, but what if contemporary public interest in science could rival public investments in sports culture?

As can be seen through my investigation of public science in the eighteenth-century, however, sustaining a robust and accessible scientific public can be difficult to achieve. In chapter three, for instance, I documented audience anxieties that public science lectures at the Royal Institution were becoming too popular, thus devaluing science by associating it with frivolous and fashionable endeavors. In response to such anxieties, many critics of the Royal Institution began circulating arguments that narrowed the scope of early nineteenth-century public science, suggesting that it was useful mainly for scientific recreation. By winnowing the possible uses of public science, as well as the avenues for public participation, such arguments helped to create sharper divisions between serious scientific study and superficial scientific entertainment. Such divisions neglected the valuable role that public science could play in mediating social relationships, forging individual and community identities, and prompting public debate about scientific matters. By limiting what public audiences could do with science, such comments inevitably restricted public science participation.

In thinking through the contemporary applications for my historical research, I argue that the present moment is facing similar difficulties in sustaining responsive public investment in science. Although contemporary public science advocates are making strides in advancing public

knowledge of STEM (Science, Technology, Engineering, and Mathematics), I argue that it is vital to promote a broad range of public science activities. While advocacy efforts that encourage students to pursue professional scientific careers are absolutely necessary, these must be balanced with more diverse and interconnected ways of engaging with science. A robust scientific public cannot be the sole domain of those who are fluent in scientific knowledge or have plans to pursue scientific careers. Nor can it be an arena devoted only to amusing scientific entertainment. By advocating for diverse and networked uses of public science, we can potentially help construct and maintain a robust scientific public open to diverse audiences, interests, and investments in science.



## REFERENCES

- Addison, Joseph. *The Spectator*. Vol. 1. London: Longmans, Green, & Co., 1898. *Hathi Trust Digital Library*. Web. 20 May 2014.
- Algarotti, Francesco. *Sir Isaac newton's philosophy explain'd for the use of the ladies. In six dialogues on light and colours. From the Italian of Sig. Algarotti*. Trans. Elizabeth Carter. Vol. 1. London: E. Cave, 1739. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- Asen, Robert. "A Discourse Theory of Citizenship." *Quarterly Journal of Speech*. 90.2 (2004): 189-211. Print.
- Baker, Henry. *The microscope made easy: or, I. The nature, uses, and magnifying powers of the best kinds of microscopes described, calculated, and explained: for the instruction of such, particularly, as desire to search into the wonders of the minute creation, tho' they are not acquainted with optics...* London: R. Dodsley, 1742. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- Baker Jr., Houston A. "Critical Memory and the Black Public Sphere." *The Black Public Sphere: A Public Culture Book*. Ed. The Black Public Sphere Collective. Chicago: The University of Chicago Press, 1995. Print.
- Barbauld, Anna Laetitia, ed. *The Correspondence of Samuel Richardson*. Vol. 1. London: Printed for R. Phillips by Lewis and Rodem, 1804. *Hathi Trust*. Web. 20 May 2014.
- Bazerman, Charles. *The Languages of Edison's Light*. Cambridge: The MIT Press, 1999. Print.
- Beauty in Search of Knowledge*. 1782. Mezzotint. British Museum.
- Becker, Bernard. *Scientific London*. New York: D. Appleton & Co., 1875. *Making of American Books*. Web. 20 May 2014.
- Bensaude-Vincent, Bernadette, and Christine Blondel. "A Science Full of Shocks, Sparks and Smells." *Science and Spectacle in the European Enlightenment*. Hampshire, UK: Ashgate, 2008. Print.
- Berger, John. *Ways of Seeing*. New York: Viking Press, 1972. Print.
- Blitefield, Jerry. "It's Showtime! Staging Public Demonstrations, Alinsky-Style." *Rhetorics of Display*. Ed. Lawrence J. Prelli. Columbia: University of South Carolina Press, 2006. Print.
- Bodek, Evelyn Gordon. "Salonnières and Bluestockings: Educated Obsolescence and

- Germinating Feminism.” *Feminist Studies* 3.3/4 (1976): 185-99. *JSTOR*. Web. 20 May 2014.
- Bolton, Sarah K. “Humphry Davy.” 1889. Illustration. *Famous Men of Science*. By Sarah K. Bolton. New York: Thomas Y. Crowell Company Publishers, 1889. *Project Gutenberg*. Web. 20 May 2014.
- Borda, Jennifer L. “The Woman Suffrage Parades of 1910-1913: Possibilities and Limitations of an Early Feminist Rhetorical Strategy.” *Western Journal of Communication*. 66.1 (2002): 25-52. Print.
- Bowles, Thomas. *Rotunda at Ranelagh Gardens*. 1754. Painting. Public Domain.
- Boyle, Robert. *Illustration of an Air-Pump*. 1662. Illustration. *New Experiments Physico-Mechanical, Touching the Spring of the Air and Its Effects*. By Robert Boyle. Oxford: H. Hall, Printer to the University, 1660. *Early English Books Online*. Web. 20 May 2014.
- . *New Experiments Physico-Mechanical, Touching the Spring of the Air and Its Effects*. Oxford: H. Hall, Printer to the University, 1660. *Early English Books Online*. Web. 20 May 2014.
- Brewer, John, and Roy Porter. “Introduction.” *Consumption and the World of Goods*. Eds. John Brewer and Roy Porter. London: Routledge, 1993. Print.
- Brower, Daniel C., and Robert Asen “Public Modalities, or Metaphors We Theorize By.” *Public Modalities: Rhetoric, Culture, Media, and the Shape of Public Life*. Eds. Daniel C. Brower and Robert Asen. Tuscaloosa: The University of Alabama Press, 2010. Print.
- Burke, Kenneth. *Attitudes Toward History*. New York: The New Republic, 1937. *Hathi Trust Digital Library*. Web. 20 May 2014.
- . *Permanence and Change: An Anatomy of Purpose*. Berkeley: University of California Press, 1984. Print.
- Burney, Frances. *Memoirs of Doctor Burney*. Vol. 1-3. London: Edward Moxon, 1832. Print.
- Cantor, G. N. “Thomas Young’s Lectures at the Royal Institution.” *Notes and Records of the Royal Society of London*. 25.1 (1970): 87-112. Web. 20 May 2014.
- Carlyle, Thomas. *New Letters of Thomas Carlyle*. Vol. 1. Ed. Alexander Carlyle. London: J. Lane, 1904. *Hathi Trust Digital Library*. Web. 20 May 2014.
- Chapone, Hester. “On Conversation” in *The Works of Mrs. Chapone, Containing*

- Letters on the Improvement of the Mind, Addressed to a Young Lady. And Miscellanies in Prose and Verse. In Two Volumes.* Dublin: J. Williams: 1775. Print.
- Charland, Maurice. "Constitutive Rhetoric: The Case of the *Peuple Québécois*." *Quarterly Journal of Speech*. 73.2 (1987): 133-150. *Taylor & Francis Online*. Web. 20 May 2014.
- Condit, Celeste Michelle. *The Meaning of the Gene: Public Debates About Human Heredity*. Madison: The University of Wisconsin Press, 1999. Print.
- Cooter, Roger, and Stephen Pumfrey. "Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Popular Culture." *History of Science*. Suppl. 3. 32.97 (1994): 237-267. Print.
- Cowper, William. *The Poems of William Cowper. Volume III: 1785-1800*. Eds. John D. Baird and Charles Ryskamp. Oxford: Clarendon Press, 1995. Print.
- Crary, Jonathan. *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century*. Cambridge: MIT Press, 1990. Print.
- Darwin, Erasmus. *A Plan for the Conduct of Female Education, in Boarding Schools, Private Families, and Public Seminaries*. Philadelphia: John Ormrod, 1798. *Early American Imprints, Series I: Evans, 1639-1800*. Web. 20 May 2014.
- Daston, Lorraine, and Katherine Park. *Wonders and the Order of Nature, 1150-1750*. New York: Zone Books, 1998. Print.
- Davy, Humphry. *The Collected Works of Sir Humphry Davy*. Vol. 3. Ed. By his brother, John Davy. London: Smith, Elder and Co., 1839-40. *Hathi Trust Digital Library*. Web. 20 May 2014.
- de Certeau, Michael. *The Practice of Everyday Life*. Berkley: University of California Press, 1984. Print.
- de St. Evremont, Charles de Marguetel de Saint Denis. *The Works of Mr. de St. Evremont, in II Volumes. Translated from the French*. Vol. 1. London: Awnsham and John Churchill, at the Black Swan in Pater-Noster-Row, 1700. *Early English Books Online*. 20 May 2014.
- Debord, Guy. *The Society of the Spectacle*. Trans. Donald Nicholson. New York: Zone, 1994. Print.
- DeLuca, Kevin Michael, and Jennifer Peeples. "From Public Sphere to Public Screen: Democracy, Activism, and the 'Violence' of Seattle." *Critical Studies in Media Communication*. 19.2 (2002): 125-151. Print.

- Donawerth, Jane. *Conversational Rhetoric: The Rise and Fall of a Women's Tradition, 1600-1900*. Carbondale: Southern Illinois University Press, 2012. Print.
- Ede, Lisa, and Andrea Lunsford. "Audience Addressed/Audience Invoked: The Role of Audience in Composition Theory and Pedagogy." *College Composition and Communication*. 35.2 (1994): 155-171. *National Council of Teachers of English*. Web. 20 May 2014.
- Edgeworth, Maria. *Letters for Literary Ladies. To Which is Added, an Essay on the Noble Science of Self-Justification*. London: J. Johnson, in St. Paul's Church-Yard, 1795. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- Eger, Elizabeth. *Bluestockings: Women of Reason from Enlightenment to Romanticism*. Basingstoke, UK: Palgrave Macmillan, 2010. Print.
- Eger, Elizabeth, Charlotte Grant, Cliona Ó Gallchoir, and Penny Warburton, eds. *Women, Writing and the Public Sphere, 1700-1830*. Cambridge: Cambridge University Press, 2001. Print.
- Elliot, Gilbert. *Life and Letters of Sir Gilbert Elliot, First Earl of Minto, from 1751-1806, when His Public Life in Europe Was Closed by His Appointment to the Vice-Royalty of India*. Vol. 3. Ed. By his great-niece the Countess of Minto. London: Longmans, Green, and Co., 1874. *Google Books*. Web. 20 May 2014.
- Ellis, Markman. *The Coffee-House: A Cultural History*. London: Weidenfeld & Nicolson, 2004. Print.
- Engeström, Yrjö. "Developmental Studies of Work as a Testbench of Activity Theory: The Case of Primary Care Medical Practice." *Understanding Practice: Perspectives on Activity and Context*. Eds. Seth Chaiklin and Jean Lave. Cambridge: Cambridge University Press, 1993. Print.
- Fahnestock, Jeanne. "Accommodating Science: The Rhetorical Life of Scientific Facts." *Written Communication*. 3.3 (1986): 275-296. *Sage Journals*. Web. 20 May 2014.
- Ferguson, James. *The Young Gentleman and Lady's Astronomy, Familiarly Explained in Ten Dialogues Between Neander and Eudasia. To Which is Added, The Description and Use of the Globes and Armillary Sphere*. Dublin: Printed By Boulter Grierson, Printer to the King's Most Excellent Majesty, 1768. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- Findlen, Paula. *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy*. Berkeley: University of California Press, 1994. Print.
- Fleckenstein, Kristie S. "Decorous Spectacle: Mirrors, Manners, and *Ars Dictaminis* in Late Medieval Civic Engagement." *Rhetoric Review*. 28.2 (2009): 111-127. Print.

- Fontenelle, Bernard de. *A Discovery of New Worlds*. Trans. Aphra Behn. London: Hesperus Press Limited, 2012. Print.
- Fontenelle, Bernard le Bovier de. *Conversations on the Plurality of Worlds*. Trans. H.A. Hargreaves. Berkeley: University of California Press, 1990. Print.
- Foote, George A. "Sir Humphry Davy and His Audience at the Royal Institution." *Isis*. 43.1 (1952): 6-12. Print.
- Fraser, Nancy. "Rethinking the Public Sphere: A Contribution to the Critique of Actually Existing Democracy." *Habermas and the Public Sphere*. Ed. Craig Calhoun. Cambridge: The MIT Press, 1992. Print.
- Gates, Barbara T., and Ann B. Shteir. "Charting the Tradition." *Natural Eloquence: Women Reinscribe Science*. Eds. Barbara T. Gates and Ann B. Shteir. Madison: The University of Wisconsin Press, 1997. Print.
- GfK Public Affairs & Corporate Communication. "The AP-GfK Poll: March, 2014." March 2014. Web. 20 May 2014. < [http://ap-gfkipoll.com/main/wp-content/uploads/2014/04/AP-GfK-March-2014-Poll-Topline-Final\\_SCIENCE.pdf](http://ap-gfkipoll.com/main/wp-content/uploads/2014/04/AP-GfK-March-2014-Poll-Topline-Final_SCIENCE.pdf)>
- Golinski, Jan. "Humphry Davy: The Experimental Self." *Eighteenth-Century Studies*. 45.1 (2011): 15-28. Print.
- . *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760-1820*. Cambridge: Cambridge University Press, 1992. Print.
- Gross, Alan G. *Starring the Text: The Place of Rhetoric in Science Studies*. Carbondale: Southern Illinois University Press, 2006. Print.
- Gryffindor. *Royal Institution in London*. 2011. Photograph. Creative Commons.
- Guenther, Michael B. *Enlightened Pursuits: Science and Civic Culture in Anglo-America, 1730-1760*. Diss. Northwestern University. Ann Arbor: UMI, 2008. *ProQuest*. Web. 20 May 2014.
- Habermas, Jürgen. *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*. Cambridge: MIT Press, 1991. Print.
- Halloran, S. Michael. "Text and Experience in a Historical Pageant: Toward a Rhetoric of Spectacle." *Rhetoric Society Quarterly*. 31.4 (2001): 5-17. Print.
- Hamilton, Mary. Diaries. 12 August 1784. HAM 2/13 3<sup>rd</sup> August to 17<sup>th</sup> August 1784. Mary Hamilton Papers. John Ryland Library. Manchester, UK. 1 June 2012.

- Hamilton, Mary. Diaries. 10 July 1784. HAM 2/11 21<sup>st</sup> June to July 15<sup>th</sup> 1784. Mary Hamilton Papers. John Ryland Library. Manchester, UK. 1 June 2012.
- Haraway, Donna J. *Modest\_Witness@Second\_Millennium. FemaleMan©\_Meets\_OncoMouse™*. New York: Routledge, 1997. Print.
- Harris, John. *Astronomical dialogues between a gentleman and a lady: wherein the doctrine of the sphere, uses of the globes, and the elements of astronomy and geography are explain'd in a pleasant, easy and familiar way with a description of the famous instrument called the orrery*. London: T. Wood, 1719. *Eighteenth Century Collection Online*. Web. 20 May 2014.
- Hauser, Gerald. *Vernacular Voices: The Rhetoric of Publics and Public Spheres*. Columbia: University of South Carolina, 1999. Print.
- Haywood, Eliza. *The Female Spectator*. Vol. 3. London: A Millar, W. Law, & R. Cater, 1775. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- Heller, Deborah. "Bluestocking Salons and the Public Sphere." *Eighteenth-Century Life* 22.2 (1998): 59-82. *Muse*. Johns Hopkins University Press. Web. 20 May 2014.
- Hesford, Wendy S. *Spectacular Rhetorics: Human Rights Visions, Recognitions, Feminisms*. Durham: Duke University Press, 2011. Print.
- Hill, Charles A. "The Psychology of Rhetorical Images." *Defining Visual Rhetorics*. Eds. Ed. Charles A. Hill and Marguerite Helmers. Mahwah: Lawrence Erlbaum Associates, 2004. Print.
- Horner, Francis. *Memoirs and Correspondence of Francis Horner, M.P.* Boston: Little, Brown and Company, 1853. *Hathi Trust Digital Library*. Web. 20 May 2014.
- Industrial Areas Foundation (IAF). *IAF 50 years: Organizing for change*. Chicago: Industrial Areas Foundation, 1990. Print.
- Irigaray, Luce. *Speculum of the Other Woman*. Trans. Gillian C. Gill. Ithaca: Cornell University Press, 1985. Print.
- Jack, Jordynn. "A Pedagogy of Sight: Microscopic Vision in Robert Hooke's *Micrographia*." *Quarterly Journal of Speech*. 95.2 (2009): 192-209. Print.
- Jarratt, Susan. *Rereading the Sophists: Classical Rhetoric Refigured*. Carbondale: Southern Illinois University Press, 1991. Print.
- Jeffrey, Francis, ed. "ART. VIII. The Bakerian Lecture on Some Chemical Agencies of Electricity." *The Edinburgh Review*. Jan. 1808: 390-398. *British Periodicals*. Web. 20 May 2014.

- . "ART.XVII. The Bakerian Lecture on the Theory of Light and Colours." *The Edinburgh Review*. Jan. 1803: 450-456. *British Periodicals*. Web. 20 May 2014.
- Johnson, R. Brimley, ed. *The Letters of Lady Louisa Stuart*. London: John Lane, 1926). Print.
- Jones, Bence. *The Royal Institution: Its Founder and Its First Professors*. London: Longmans, Green, 1871. *Hathi Trust Digital Library*. Web. 20 May 2014.
- Kaplan, E. Ann. *Women and Film: Both Sides of the Camera*. New York: Methuen, 1983. Print.
- Keen, Paul. *Literature, Commerce, and the Spectacle of Modernity, 1750-1800*. New York: Cambridge University Press, 2012. Print.
- Kennedy, Verne. R. Amplification: A Central Theme in Late Medieval Rhetoric. *Central States Speech Journal*, 19:3 (1968), 214-218. *Taylor & Francis Online*. Web. 20 May 2014.
- Klein, Lawrence E. "Gender, Conversation and the Public Sphere in Early Eighteenth-Century England." *Textuality and Sexuality: Reading Theories and Practices*. Eds. Judith Still and Michael Worton. Manchester: Manchester University Press, 1993. Print.
- . "Gender and the Public/Private Distinction in the Eighteenth Century: Some Questions about Evidence and Analytic Procedure." *Eighteenth-Century Studies* 29.1 (1996): 97-109. *Muse. The American Society for Eighteenth-Century Studies*. Web. 20 May 2014.
- Knabb, Ken, ed. "Definitions." *Situationist International Anthology*. Trans. Ken Knabb. Berkeley: Bureau of Public Secrets, 1981. Print.
- Lady. *An Essay in Defence of the Female Sex. In a Letter to a Lady*. 4<sup>th</sup> ed. London: S. Butler, next Bernard's-Inn in Holborn, 1721. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- Latour, Bruno. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press, 2005. Print.
- Lennox, Charlotte. *The Lady's Museum: By the Author of The Female Quixote*. Vol. 1 & 2. London: J. Newberry in St. Paul's Church-Yard, and J. Coote in Pater Noster Row, 1760-1761. *Eighteenth Century Collections Online Text Creation Partnership*. Web. 20 May 2014.
- Lessig, Lawrence. *Remix: Making Art and Commerce Thrive in the Hybrid Economy*.

- New York: The Penguin Press, 2008. Print.
- London Unmask'd: or The New Town Spy. Exhibiting a Striking Picture of the World as It Goes. In a Ramble through the Regions of Novelty, Whim, Fashion and Taste, as Found in the Cities of London and Westminster...* London: Printed for William Adlard, No. 10, Salisbury Square, Fleet Street, 1784?. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- Longinus. *Longinus on the Sublime*. Trans. R. Lowth. Oxford: The Clarendon Press, 1906. Print.
- Marcet, Jane. *Conversations on Chemistry, in which the elements of that science are familiarly explained and illustrated by experiments*. 4<sup>th</sup> ed. Greenfield, Mass: Denio and Phelps, 1818. *Early American Imprints*. Web. 20 May 2014.
- Martin, Benjamin. *The Young Gentleman and Lady's Philosophy in a Continued Survey of the Works of Nature and Art: by Way of Dialogue...* Vol. 1 & 2. London: W. Owen. 1759-1763. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- . *Illustration From The Young Gentleman and Lady's Philosophy*. 1759-1763. Illustration. *The Young Gentleman and Lady's Philosophy in a Continued Survey of the Works of Nature and Art: by Way of Dialogue...* Vol. 1. London: W. Owen. 1759-1763. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- Merritt, Juliette. *Beyond Spectacle: Eliza Haywood's Female Spectators*. Toronto: University of Toronto Press, 2004. Print.
- Montagu, Elizabeth. *Elizabeth Montagu: Queen of the Bluestockings, Her Correspondence from 1720 to 1761*. Ed. Emily J. Climençon. Vol. 1. London: John Murray, 1906. Print.
- . Letter to the Duchess of Portland. n. d. PwE30. Manuscripts and Special Collections, University of Nottingham, Nottingham, K. 1 June 2012. Print.
- . Letter to Mrs. Dornellan. n.d. PwE57. Manuscripts and Special Collections, University of Nottingham, Nottingham, K. 1 June 2012. Print.
- Montagu, Elizabeth Robinson. Letter to Sarah Robinson. 8 March 1768. Correspondence. Henry E. Huntington Library. San Marino, CA. 20 May 2014.
- More, Hannah. *Florio: a Tale, for Fine Gentlemen and Fine Ladies: and, the Bas Bleu; or, Conversation: Two Poems*. London: T. Cadell, in the Strand, 1786. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- . *Strictures on the Modern System of Female Education*. 3<sup>rd</sup>. ed. Vol. 2. Print.



- London: T. Cadell and W. Davies, 1799. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- Morning Post and Daily Advertiser*. 7 November 1786. London. *17<sup>th</sup> and 18<sup>th</sup> Century Burney Collection Newspapers*. Web. 20 May 2014.
- . 6 October 1785. London. *17<sup>th</sup> and 18<sup>th</sup> Century Burney Collection Newspapers*. Web. 20 May 2014.
- Morus, Iwan Rhys. "Seeing and Believing Science." *Isis* 97.1 (2006):101-110. *JSTOR*. Web. 20 May 2014.
- . "Worlds of Wonder: Sensation and the Victorian Scientific Performance. *Isis* 101.4 (2010): 806-816. *JSTOR*. Web 20 May 2014.
- Mulvey, Laura. "Visual Pleasure and Narrative Cinema." *Screen* 16 (1975): 6-18. Print.
- Myers, Greg. "Fictionality, Demonstration, and Forum for Popular Science: Jane Marcet's *Conversations on Chemistry*." *Natural Eloquence: Women Reinscribe Science*. Eds. Barbara T. Gates and Ann B. Shteir. Madison: The University of Wisconsin Press, 1997. Print.
- Nicholas, John, ed. "Domestic Occurrences." *Gentleman's Magazine*. April 1800: 382. *British Periodicals*. Web. 20 May 2014.
- Phillips, Patricia. *The Scientific Lady: A Social History of Women's Scientific Interests, 1520-1918*. New York: St. Martin's Press, 1990. Print.
- Piozzi, Hester Lynch. *British Synonymy: or, an Attempt at Regulating the Choice of Words in Familiar Conversation*. Vol. 2. London: G. G. and J. Robinson, Paternoster-Row, 1794. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- "Plurality of Worlds." 1686. Illustration. *Conversations on the Plurality of Worlds*. By Bernard le Bovier de Fontenelle. Trans. H.A. Hargreaves. Berkeley: University of California Press, 1990. Cover. Print.
- Potter, Elizabeth. *Gender and Boyle's Law of Gases*. Bloomington: Indiana University Press, 2001. Print.
- Prelli, Lawrence, J. "Rhetorics of Display: An Introduction." *Rhetorics of Display*. Ed. Lawrence J. Prelli. Columbia: University of South Carolina Press, 2006. Print.
- Procter, David. E. "The Dynamic Spectacle: Transforming Experience into Social Forms of Community." *Quarterly Journal of Speech*. 76.2 (1990): 117-133. *Taylor & Francis Online*. Web. 20 May 2014.

- Rice, Jenny. *Distant Publics: Development Rhetoric and the Subject of Crisis*. Pittsburgh: University of Pittsburgh Press, 2012. Print.
- Rivers, Nathaniel A., and Ryan P. Weber. "Ecological, Pedagogical, Public Rhetoric." *College Composition and Communication*. 63.2 (2011): 187-218. NCTE. Web. 20 May 2014.
- Rousseau, G. S. *Enlightenment Borders: Pre- and Post-Modern Discourses, Medical, Scientific*. Manchester: Manchester University Press, 1991. Print.
- Royster, Jacqueline Jones and Gesa Kirsch. *Feminist Rhetorical Practices: New Horizons for Rhetoric, Composition, and Literacy Studies*. Carbondale: Southern Illinois University Press, 2012. Print.
- Rumford, Benjamin, Graf von. *Proposals for Forming by Subscription, in the Metropolis of the British Empire, a Public Institution for Diffusing the Knowledge and Facilitating the General Introduction of Useful Mechanical Inventions and Improvements, and for Teaching, By Courses of Philosophical Lectures and Experiments, the Application of Science to the Common Purposes of Life*. London: s.n., 1799. *Eighteenth Century Collections Online*. Web 20 May 2014.
- Scott, J. Blake. *Risky Rhetoric: AIDS and the Cultural Practices of HIV Testing*. Carbondale: Southern Illinois University Press, 2003. Print.
- A Series of Letters Between Mrs. Elizabeth Carter and Miss Catherine Talbot From the Year 1741 To 1770. To Which are Added, Letters from Mrs. Elizabeth Carter to Mrs. Vesey, Between the Years 1763 and 1787; Published from the Original Manuscripts in the Possession of the Rev. Montagu Pennington, M.A. Vicar of Northbourn [sic], in Kent, Her Nephew and Executor. In Two Volumes*. London: F.C. and J. Rivington, 1808. Print.
- Shapin, Steven, and Simon Schaffer. *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*. Princeton: Princeton University Press, 1985. Print.
- Shapiro, Barbara. *A Culture of Fact: England, 1550-1720*. Ithaca: Cornell University Press, 2000. Print.
- Shepard, Thomas Hosmer. *Royal Institution of Great Britain*. Circa 1838. Painting. Public Domain.
- Sheridan, David M., Jim Ridolfo, and Anthony J. Michel. *The Available Means of Persuasion: Mapping a Theory and Pedagogy of Multimodal Public Rhetoric*. Anderson, SC: Parlor Press, 2012. Print.
- Silliman, Benjamin. *A Journal of travels in England, Holland and Scotland, and of two*

- passages over the Atlantic, in the years 1805 and 1806.* 3<sup>rd</sup> ed. New Haven: S. Converse, 1820. *Hathi Trust Digital Library*. Web. 20 May 2014.
- Simond, Louis. *Journal of a Tour and Residence in Great Britain, during the years 1810-1811.* 2<sup>nd</sup> ed. Vol. 1 and 2. Edinburgh: J. Ballantyne and Col for A. Constable and Co., 1817. *Hathi Trust Digital Library*. Web. 20 May 2014.
- Southey, Robert. *Letters From England.* 3<sup>rd</sup> ed. London: Longman, Hurst, Rees, Orme, and Brown, 1814. *Hathi Trust Digital Library*. Web. 20 May 2014.
- Stafford, Barbara Maria. *Artful Science: Enlightenment Entertainment and the Eclipse of Visual Education.* Cambridge: The MIT Press, 1994. Print.
- Stafford, Barbara, Maria, and Frances Terpak. *Devices of Wonder from the World in a Box to Images on a Screen.* Los Angeles: The Getty Research Institute, 2001. Print.
- Steele, Richard. *The Englishman: Being the Sequel of the Guardian.* Dublin: Printed and Sold by James Carson, 1714. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- Steele, Richard, and Joseph Addison. *The Guardian: A New Edition, Carefully Revised, In Two Volumes.* Vol. 2. Ed. Alexander Chalmers. London: Printed for F.C and J. Rivington, et al., 1822. Print.
- Stewart, Larry. *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660-1750.* Cambridge: Cambridge University Press, 1992. Print.
- Stifler, James Madison. *"My Dear Girl": The Correspondence of Benjamin Franklin with Polly Stevenson, Georgiana and Catherine Shipley.* New York: George H. Doran Company on Murray Hill, 1927. Print.
- Stillingfleet, Benjamin. *An Essay on Conversation.* London: Thomas Ruddiman for L. Gilliver and J. Clarke, at Homer's Head in Fleet Street, and at their Shop in Westminster-Hall, 1737. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- Telescope, Tom. *The Newtonian System of Philosophy Adapted to the Capacities of Young Gentlemen and Ladies, and Familiarized and Made Entertaining by Objects with which They are Intimately Acquainted: Being the Substance of Six Lectures Read to the Lilliputian Society, By Tom Telescope, A.M. and Collected and Methodized for the Benefit of the Youth of These Kingdoms, by Their Old Friend Mr. Newberry...* London: J. Newberry, at the Bible and Sun, in St. Paul's Church Yard, 1761. *Eighteenth Century Collections Online*. Web. 20 May 2014.
- Tonn, Mari Boor. "'From the Eye to the Soul': Industrial Labor's Mary Harris 'Mother'"

- Jones and the Rhetorics of Display.” *Rhetoric Society Quarterly*. 41.3 (2011): 231-249. Print.
- Traweek, Sharon. *Beamtimes and Lifetimes*. Cambridge: Harvard University Press, 1988. Print.
- Walters, Alice N. “Conversation Pieces: Science and Politeness in Eighteenth-Century England.” *History of Science*. 35.108 (1997): 121-154. Print.
- Warner, Michael. *Publics and Counterpublics*. New York: Zone Books, 2005. Print.
- Wells, Susan. *Out of the Dead House: Nineteenth-Century Women Physicians and the Writing of Medicine*. Madison: The University of Wisconsin Press, 2001. Print.
- . “Rogue Cops and Health Care: What Do We Want from Public Writing?” *College Composition and Communication*. 47.3 (1996): 325-341. *JSTOR*. Web. 20 May 2014.
- Wright of Derby, Joseph. *An Experiment on a Bird in the Air Pump*. 1768. Painting. The National Gallery, London.
- Young, Thomas. *A Course of Lectures on Natural Philosophy and the Mechanical Arts*. London: Printed for J. Johnson, 1807. *Biodiversity Heritage Library: Contributing Library University of California Libraries*. Web. 20 May 2014.